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TP 7522E

Tilt Table – User's Manual

Prepared for
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Development Centre
Transport Canada

by
Centre de recherche industrielle du Québec

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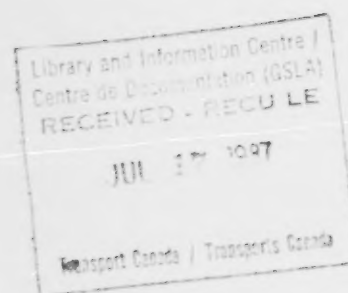
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USER'S MANUAL

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The contents of this report reflect the views of the contractor and not necessarily the official views or policies of the Transportation Development Centre.

Un sommaire en français de ce rapport est inclus avant la table des matières.

Ce document est également disponible en français: "Table de renversement - Manuel de l'utilisateur", TP 7522F.

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17. Abstract A tilt table has been designed, built and installed for Transport Canada. This test equipment is basically a laterally tilting platform on which heavy vehicles are driven and inclined in order to determine their rollover threshold. This manual provides a brief description of the tilt table and its installation, operation and maintenance. It also contains schematic diagrams of the hydraulic and electrical systems and the weighing pads. Technical specifications of the components are presented in appendices.			
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17. Résumé Une table de renversement a été conçue, construite et mise sur pied pour Transports Canada. Cet appareil d'essai est une plate-forme inclinable latéralement sur laquelle les camions lourds sont installés afin de déterminer leur seuil de renversement. Le présent manuel présente une brève description de la table et contient toutes les instructions pour son installation, son utilisation et son entretien. Il contient également des schémas de principe du système hydraulique, du système électrique et des plateaux de mesure. Les spécifications techniques des composantes sont présentées en annexe.			
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SUMMARY

The "Tilt table - user's manual" covers all the aspects of the installation, use and maintenance of the tilt table built for Transport Canada. It describes in detail all the steps required to install the table at a new test location along with all the adjustments then needed. Verification procedures before each new series of tests are also described. Finally, the periodic maintenance of the table is enumerated with the special care recommended for its storage. The schematic diagrams, list of materials and technical specifications complete this manual.

SOMMAIRE

Le manuel de l'utilisateur de la table de renversement construite pour Transports Canada couvre tous les aspects de son installation, son utilisation et son entretien.

Il décrit en détail les différentes étapes de l'installation de cette table à un nouveau site d'essai ainsi que tous les ajustements alors nécessaires. Les vérifications devant être faites avant chaque nouvelle série d'essais afin de s'assurer du bon fonctionnement de la table y sont énumérées. Enfin, l'entretien périodique des différents systèmes est passé en revue de même que les précautions nécessaires pour l'entreposage. Les schémas, les listes de pièces et les spécifications techniques des composantes complètent le manuel.

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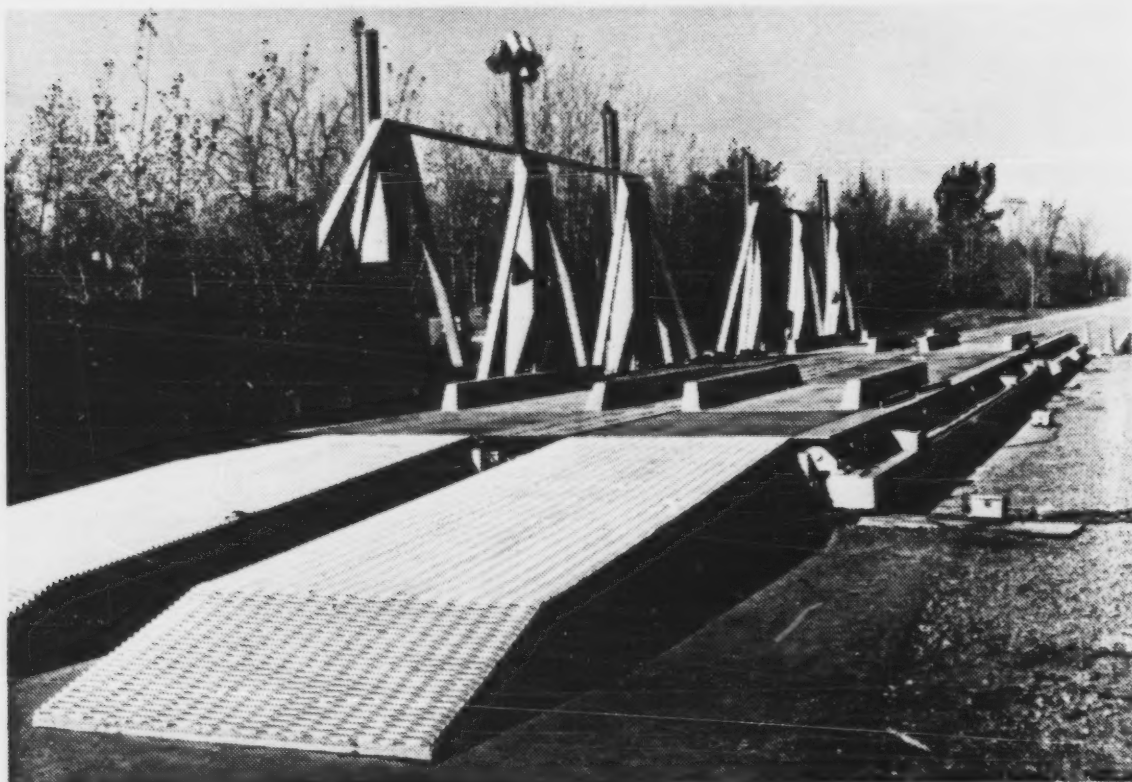
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WARNING

The data, description and procedures in this manual are given for the tilt table as built for and delivered to Transport Canada's Motor Vehicle Test Centre in Blainville, Québec.

If, for any reason, modifications are made to this table, it is the responsibility of the user to up-date this manual.



TILT TABLE

1.0 DESCRIPTION OF THE TILT TABLE

1.1 Description

A tilt table is a test apparatus designed to measure the lateral rollover threshold of vehicles, specially heavy trucks and buses. Basically, it is a laterally inclinable platform on which the test vehicles are driven.

The table built for Transport Canada is designed to simply be put on a solid level ground. It is composed of two similar halves, each one consisting of a base supporting a tilting platform. Access ramps at each end complete the table's mechanical structures. The hydraulic equipments, at the exception of the four cylinders, are all mounted on a frame which is installed close to the table, on the cylinder side. Five weighing pads can be installed at any place along the table top, allowing the measurement of the load on each axle group during tilt tests. Some electrical controls complete the table.

Figure 1 shows the general assembly of the tilt table.

1.2 Weights and dimensions

The basic tilt table is 24.5 m long and 4.3 m wide; at each end the access ramps add 4.6 m for a total of 33.6 m operating length. On the cylinder side of the table, there must be a space for the hydraulic group (2.5 m x 2.5 m) and for controls and instrumentation. Before driving on the table, the vehicles need sufficient space to get in good alignment with the table. For typical tractor/trailer combinations, a roadway of about 80 m minimum will be required while straight body trucks and buses need about 30 m. A typical tilt table localization layout is given in figure 2 with all the important dimensions.

The various components of the tilt table have never been weighed, but their respective weights were estimated as follows:

- complete base (2 half bases)	4 820 kg
- tilting platform (2 half platforms)	18 900 kg
- access ramps (4 ramps)	3 900 kg
- weighing pads (5 pads)	4 225 kg

- wood roadway covering (105 blocks)	1 910 kg
- hydraulic cylinders (4 cylinders)	580 kg
- hydraulic group (dry weight)	980 kg
- vehicle tie down hooks and chains	250 kg
- electrical cables and protection tubings	150 kg
- controls and miscellaneous	25 kg

Total running weight	35 740 kg
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2.0 INSTALLATION OF THE TILT TABLE

2.1 Preparation of the site

The tilt table must be installed on relatively level ground; which must not have a slope greater than 0.4% otherwise it will be impossible to bring the platform to level with only the adjustable supports. The ground must be able to support a minimum of 75 psi under the table and under the access ramps. The roadway at each end of the table must be solid enough for heavy traffic.

The length of the roadways at each end of the table must be sufficient to allow correct alignment of the vehicles before they get on the table. The vehicles must also be able to drive off the table in a straight line. Figure no 2 gives a typical tilt table installation.

2.2 Installation of the structures

The table can be transported by truck trailers having a bedlength of 12.2 m (40 ft) or more. Normally, for transportation, the table will be separated into two major sub-assemblies, each composed of a base and of a platform retained together by five pivots. The total structure will be of 12.2 m (40 ft) in length and of 4.3 m (14 ft) in width.

For the installation on a new site, the following instructions are recommended:

- Adjust all the supporting screws so they exceed the bottom of the base by about 5 cm.
- Put the twelve base plates of the supports approximately where they will sit when the table will be installed; make sure they are sitting flat on the ground.
- With a crane and appropriate slings, bring each base and platform sub-assembly over the supports, engage the screws in the guide tube of the base plates and lower the structure to the ground. Carefully place the two sub-assemblies in the right order i.e. with the perforated transversal end tube of the base at the centre of the table in order to be able to install the junction bolts.
- Align the two bases and adjust the screw of each support so that both platforms are level, and all the pivots of the platforms are in line.
- Install the access ramps at both ends of the table and adjust their height so they match with the table top surface.

- If they have been removed for transportation, install the four hydraulic cylinders. Note: The two cylinders close to the centre of the table must be installed with shims on their two pivots in order to eliminate side play. This is very important as these cylinders are used to detect the longitudinal inclination of each platform.
- The junction bolts between the two bases should be installed only when the hydraulic system is operative in order to avoid tilting the platforms with the crane as this could displace the bases.

If the bases and platforms have been separated for transportation, the bases will be installed first and the junction bolts will be put in place. Each platform will then be placed on each base and fixed with the five pivots. The platforms must be put back into their original base as level detectors and synchronization switches are not symmetrical. More over, manufacturing tolerances on structures of this size may not allow interchangeability.

2.3

Installation of hydraulic equipments

The hydraulic group must be placed on the side of the table close to cylinder no 1, where there are three hydraulic couplings. Placing wood blocks between the ground and the base frame of the group is recommended; the group must be stable and reasonably at level.

Install the four flexible hydraulic hoses, coming from the hydraulic group, as per follows:

- hose no 1, directly to cylinder no 1;
- hose no 2, to top tube (going to cylinder no 2);
- hose no 3, to middle tube (going to cylinder no 3);
- hose no 4, to bottom tube (going to cylinder no 4).

Hose numbers can be found on the hydraulic group exit manifold.

Install the two flexible hoses in the centre of the table; these bring oil to cylinders no 3 et no 4.

2.4 Installation of the electrical equipments

2.4.1 INSTALLATION OF THE ELECTRICAL EQUIPMENTS

First the two platform level detector boxes must be installed on cylinders no 2 and no 3. These boxes are simply attached to the cylinders with special straps and there is a terminal block inside each box for electrical connections. The height of the box must be adjusted so that the needle attached to the trunnion of the cylinder is long enough to activate the four switches. Figure 3 shows a level detector box installed on a cylinder.

At the junction of the two platforms, install the two platform synchronization switches. Figure 4 shows the correct installation of these switches; platform no 1 holds the switches while the actuators are attached to platform no 2. Electrical connections are made directly inside each switch.

The other electrical equipments to install are:

- the flexible cable between the two bases; it is connected directly inside the two junction boxes located on the bases close to the centre of the table;
- if it has been removed, the limit switch under the platform no 1 must be re-installed. This switch is simply bolted to the bracket under the platform no 1 close to the centre of the table (approximately under the synchronization switches);
- the inclinometer which goes on platform no 2, close to the centre of the table; is to be hooked up to the instrumentation only during tilt tests.

2.5 Installation of the weighing pads

The weighing pads are simply put in the two recesses on top of the platform at any place along the table roadway. The only thing to check is their orientation so their electrical connector is facing the centre of the table. Their longitudinal position has no importance as they will have to be moved according to the axle spacings of the vehicle to be tested.

The electrical cables from the weighing pads to the instrumentation will be installed by the test crew just before tests. They run inside the two centre channels and the cables are all long enough to reach the pads at any place along the table. Figure 5 shows a typical installation of these cables.

The roadway recess between the weighing pads is covered with pieces of wood 10 x 30 x 120 cm (4 x 12 x 47 in.).

The track width is 102 in. when the two 4 x 6 steel tubes are both placed on the cylinder side. By moving one tube to the inside of this recess, the track increases to 108 in.; placing both tubes close to the centre of the table gives a 114 in. track.

2.6 Adjustments and verification

After the installation of the table is completed, the level of the platforms should be checked and readjusted if needed; the table should be kept as low as possible and all the supports must rest firmly against the ground. The height of access ramps must also be re-adjusted to match the top of the table.

The platform level controller switches must be adjusted according to the following procedure:

- First, verify that each level controller box is well centered on the cylinder so the needle attached to the cylinder trunnion is in the centre of the slot at the bottom of the box and its height allows the needle extension to activate the four switches.
- The needle extension inside the box must be adjusted so it is in the centre of the four switches; this is possible by loosening and re-tightening the four screws attaching the extension to the main needle.
- The two top switches are adjusted so that they reset as close as possible to the actuator; contact is engaged on at about 2 mm from the central position. Figure 6 gives the position of each switch inside the level controller box and indicates how to adjust them.
- The two bottom switches are adjusted so that the contacts shut off at about 6 mm from the central position. Their adjustment is less critical as they only indicate that the level correcting circuits are not able to keep the platforms within limits and advise the operator to stop.

In order to eliminate the effects of all the pivot slacks, the preceding adjustments should be done with the platform lifted a few centimeters off the base, but always at level longitudinally.

The adjustment of the platform synchronization switches located in the centre of the table should be done as per following instructions (see figure 4):

- make sure the levers of the switches are horizontal;
- adjust top and bottom actuators of the inside switch with a play of 3 mm with respect to the lever wheel;
- for the outside switch (switch S6), adjust top and bottom actuators with a 10 mm play with respect to the lever wheel.

The hydraulic system should then be put into service; first, make sure the hydraulic oil reservoir is full and that the valve between the reservoir and the pump is completely open (handle in line with the hose). The engine can then be started with the pump's unloading valve open (handle aligned with the engine); after warm-up, close the unloading valve to built-up pressure in the system. Pressure should be 2000 psi. To start the bleeding of the system, the bleeding valves on top of the four cylinders are left fully open while one pushes and maintains the up button down until oil starts to flow out of the cylinder's bleeding valves. These valves are then closed and we can proceed with the final bleeding. For this fine bleeding the platform is lifted about 15 cm and each bleeding valve is then opened to let the remaining air get out. This is repeated until there is no more air in each cylinder. The table is then raised and lowered a few times in order to make sure all the air in the system reaches the cylinders. After the system has rested a few minutes, fine bleeding is repeated.

It is recommended to repeat fine bleeding after a certain time to make sure all the air has been eliminated from the hydraulic system. An alternative way to quickly bleed the system is to connect all the bleeding valves to the reservoir and to run an important quantity of oil throughout the cylinders. This technique is recommended when and if someone has difficulties to get rid of air in the system.

It is normal for the table to go down slowly when there is no load on; moreover, when the oil is cold, the descent speed can be very slow.

3.0 OPERATION OF THE TABLE

3.1 Preparation for tilt tests

3.1.1 VERIFICATION OF THE HYDRAULIC SYSTEM

Before starting a series of tilt tests, specially when the table has not been used for a certain period of time, the following items must be checked on the hydraulic system:

- hydraulic oil level, the reservoir must be full with the cylinders down;
- diesel fuel level;
- engine crankcase oil level;
- engine coolant level;
- battery water level;
- hydraulic pressure available, it must be 2000 psi at 1800 rpm;
- fine bleeding of the system.

Raise and lower the table without any load for a few times, check for any leak and make sure everything is working properly.

3.1.2 VERIFICATION OF THE ELECTRICAL CONTROLS

While operating the table without any load, check the table's response to the up and down commands and check the cylinder's synchronization. A good way to check the functioning of the level controller is to manually activate the top switches and to verify if the generated correction moves the needle away from the activated switch. If needed, the correction speed can be changed by adjusting the flow control valves on the hydraulic group; a too slow correction speed may require the table to be stopped to allow correction to take place while on the other hand, a too fast correction speed may induce table oscillations.

3.1.3 VERIFICATION OF THE WEIGHING PADS

After the weighing pads have been connected to the measuring instrumentation and the calibration has been completed, it is recommended to check the reaction of these pads to a known weight or at least to the same weight with all pads.

The design of the weighing pads requires the load cells to support most of the pad's own weight. The adjustment of the zero on the measuring instrumentation compensates for this initial load but it must be remembered that the load cells only see the load perpendicular to the top of the table; therefore a correction will be needed when the pads are tilted. After adjusting the zero, the net output from the cells is a function of the perpendicular load on the pad and of the tilt angle.

$$\text{SIGNAL} = \text{PERPENDICULAR LOAD} - \text{PAD WEIGHT} \times (1 - \cos A)$$

When the table is tilted without a load on a pad, the reading goes down as the tilt angle increases. The pad's supported weight being 745 kg, the total load reading will be:

0 kg at 0 degree of tilt
-11 kg at 10 degrees of tilt
-45 kg at 20 degrees of tilt
-100 kg at 30 degrees of tilt

For the same reason as mentioned before, perpendicular weight readings will have to be corrected in order to get the weight on a pad and not the weight on the load cells. The correction is done using this equation:

$$\text{PERPENDICULAR LOAD} = \text{SIGNAL} + \text{PAD WEIGHT} \times (1 - \cos A)$$

3.2 Operation of the table

3.2.1 LOCALIZATION OF THE WEIGHING PADS

In order to facilitate the synchronization of the cylinders, the load on each cylinder should be as equal as possible. Even if corrections are applied automatically, the raising and lowering speeds will be more uniform if the load is well distributed on both platforms. Ideally, the test vehicle should be located so that the resultant of the load on each platform is as close as possible to the centre of each platform.

The distances between each axle group centre must be measured and the weighing pads located accordingly. Normally, for a conventional tractor and trailer, the trailer axles will be on one platform and the tractor front and drive wheels on the other platform. Having

one axle group close to the end of one platform should be avoided specially when this is the only load on this platform. In any case, the loading on one platform cannot exceed the limit given in figure 8.

3.2.2 INSTALLATION OF THE TEST VEHICLE

The test vehicle should be driven on the tilt table as close as possible to the low side tire lateral rest of the weighing platform. This assures the tires of the vehicle will rest firmly against the sides of the weighing pads therefore eliminating the risk of any slippage during the tilt test.

Once the vehicle has stopped at the correct location, the restrain system must be installed on the high side of the vehicle. Each platform has 9 hooks welded to the structure on the cylinder side to which a series of chains may be attached. The major problem is often to find solid attachment points on the vehicle itself. If trailers have side load hooks, it is recommended to install many chains from these hooks to the table anchor points leaving enough slack to allow suspension extensions. Six to eight inches of slack is generally enough but always remember that it is better to repeat the tilt test with more slack than to have too much at first. If the vehicle does not have side hooks, it is possible to use the special restrain system over the tire; in this case, the suspension must have a solid vertical restrain. The installation of this restrain system starts by putting a bent flat bar over the tires; chains are added between the table and the hooks at the extremities of the steel bar. Figure 7 shows the recommended way to install the chains. Under no circumstances, must the chain tensions allow the steel bar to open over the tires. With this type of restrain, the chain's slack is lesser as it only has to account for the tire spring back.

Finally, for vehicles not suitable for either of the above restrain methods, a series of straps attached to the table hooks and encircling the vehicle and its loading should be considered.

One must not forget that the vehicle at rollover threshold, is in unstable equilibrium on the low wheel side and, therefore, theoretically no force is demanded from the restrain system. However, if the vehicle goes over the point of equilibrium or if at equilibrium, there is a break in suspension or a displacement of the load, the forces in the restrain

system may become very large specially if there was too much slack. It is always very important to install many chains between the vehicle and the table, to make sure the load on the vehicle is well tied down; and to operate the table at low speed close to the rollover threshold.

3.2.3

TILT TEST

With the measuring instrumentation running, the operator tilts the table by pushing and maintaining the UP button down. He must check the tilting of the table and stop the raising if the alarm, indicating a bad synchronization of the cylinders, goes on or if he detects a problem; at all time, the emergency switch deactivates all the equipments. It is always preferable to operate the table at low speed (speed control levers low) this, leaving more time for the level and synchronization corrections to take place and there is less chance an alarm condition could be reached. This is specially true when tilting a vehicle which does not permit a good distribution of the loads on the cylinders. If the raising or lowering of the table is stopped immediatly when the alarm goes on, the correcting circuits will always be capable of bringing the table back within acceptable level and synchronization limits.

There must always be enough fuel for the engine, because even if the table goes down on its own weight, pressure is needed to open the main valve and the piloted check valves. If one must lower the table without pressure, he must push the limit switch under platform no 1, close to the centre. This opens the four equalizing valves and the table goes down slowly; however, platform level and synchronization must be checked constantly because the correcting circuits are then bypassed. If the table reaches a bad position, simply release the limit switch and leave the synchronization circuits time to correct the situation. Always remember that the emergency switch and/ or the key switch can be used to stop the table by de-energizing all the valves.

Vehicle oscillations must be avoided and tilts at low and constant speed give the best results. At the very beginning of a tilt, the compressibility of oil itself, causes a delay in the raising of the most loaded cylinders; it is recommended to stop after about 10 cm of cylinder extension to give time to the correcting circuits to react.

It is very important to stop lowering the table when the alarm goes on; for it is possible that a low weight carrying cylinder goes down very slowly even if its equalizing valve is open; this may happen when there is not enough pressure to fastly push the oil out of this cylinder fast.

3.2.4 DISEMBARKATION OF THE VEHICLE

After the two platforms have gone back to their original position i.e. resting against the bases, the tie down chains should be removed and the vehicle driven off the table.

3.3 Tilt table capacities

The tilt table is designed to operate within the following limits which should never be exceeded:

- Maximum tilt angle - 35 degrees (limited by cylinder stroke).
- Raising speed - 35 degrees of tilt in 70 sec. without load and at high speed.
- 35 degrees of tilt in 135 sec. without load and at low speed.
- Lowering speed - The lowering speed depends on the load on the table and on the oil temperature. Without load and at low temperature, it takes close to 250 sec. However, with a typical truck and a temperature of 18 degrees, it goes from 20 to 0 degrees in about 70 sec.
- Maximum load - The maximum load the table can take depends on how this charge is distributed. If it is uniformly distributed, the table can handle a total load of 135 000 kg with 67 500 kg on each platform. However, with trucks, the loads are always concentrated at axles and generally speaking, axle loads should be limited to 12 000 kg. On the other hand, in order not to exceed the maximum capacity of each cylinder, the resultant of all the loads on each

platform must not be higher than the limit given in figure 8.

Weighing pads

- Each weighing pad is supported by four load cells with a nominal capacity of 11 400 kg (25 000 lb) installed at each corner. This gives a total capacity of 45 600 kg (100 000 lb) when the load is uniformly distributed over the four cells. However when a vehicle is tilted, all the load supported by one axle is shifted to the low side tires; in these conditions, three 12 000 kg axles on one weighing pad approach the limit on the lowest load cells. Specifications of the load cells are given in appendix C.

4.0 MAINTENANCE

4.1 Periodic maintenance

4.1.1 MAINTENANCE OF THE STRUCTURE

The metallic structure requires very little maintenance. In order to prevent corrosion, it is recommended to have paint touch-ups done every year. It is also a good practice to check the level and alignment of both bases and platforms every spring after thaw. At this time, the screws of the supports should be checked for correct operation and covered with a thick film of grease. Light oil should be sprayed on platform and cylinder pivots.

4.1.2 MAINTENANCE OF THE HYDRAULIC SYSTEM

4.1.2.1 Maintenance of the engine

Every year, the following maintenance should be done to the engine:

- Drain and change engine oil.
- Replace oil filter.
- Check and replace if needed the air filter.
- Check engine coolant level.
- Check engine coolant freezing point; add antifreeze if needed.
- Check battery electrolyte level and density.
- Run the engine and check the functioning of the battery charging system.
- Check the functioning of the engine cut off system by simulating a loss of oil pressure (disconnect the sending wire) and a hot engine (ground the temperature sensor wire). This should shut down the fuel supply valve and the engine should stop shortly after.

If the engine is used frequently, oil and filter should be changed every 50 running hours.

The FORD maintenance manual gives more details and their recommendations have priority on any others.

4.1.2.2 Maintenance of the hydraulic equipments

The annual verifications which should be done on the hydraulic equipments are:

- verification of the hydraulic oil level;
- verification of all the hydraulic fittings for any damage and/or leakage.

There is no maintenance particular to each component; consult appendix A for the specifications of each component.

4.1.3 MAINTENANCE OF THE ELECTRICAL EQUIPMENTS

The electrical equipments do not require any particular maintenance; however, it is recommended to check annually if the wiring has not been damaged and to repair if needed.

4.1.4 MAINTENANCE OF THE WEIGHING PADS

The annual maintenance recommended for the weighing pads consists of:

- paint touch-ups to stop corrosion;
- verifying if the reaction rods and the load applicators move freely;
- lubricating all pivots with light oil;
- making sure the electrical connectors have their protection caps.

4.2 Storage of the tilt table

Normally the tilt table can be left outside without any particular protection. However, one must make sure:

- the engine coolant freezing point is lower than the lowest expected temperature;
- the battery is disconnected and fully charged to avoid the freezing of its electrolyte (when possible it should be stored inside);
- all the electrical connectors have protection caps.

It is also recommended to cover the hydraulic group with a turpalin and to store in a dry place: the control box, the cables for the weighing pads, the tie down chains and hooks and the battery. The wood blocks should be piled up with air space on the table and covered to protect them from rain.

5.0 SCHEMATIC DIAGRAMS AND TECHNICAL SPECIFICATIONS

5.1 Hydraulic system

The hydraulic system of the tilt table uses a diesel engine as prime mover. The engine drives a flow compensated pump delivering up to 115 l/min (30 US gmp) at 1800 rpm. The schematic diagram given in appendix A shows that during the tilting of the table, oil first goes through a flow regulator which controls the tilting speed. Then oil goes through the main valve, the check valve of the lowering speed flow regulator and reaches a rotary flow divider. This gear flow divider separates the total flow into four theoretically equal parts which reach each cylinder after going through a piloted check valve and a hose break valve. The piloted check valves are required to prevent at rest, oil leakage from a high pressure cylinder to a low pressure one through the flow divider. On the other hand, the hose break valves are installed only for safety reason; they block the cylinder exit if the flow out of this cylinder, gets too high as in the case of a broken hose.

On the circuit of each cylinder there is a pressure relief valve and an equalizing valve both connected to the reservoir. The pressure relief valves are needed to avoid build up of excessive pressures if the flow divider should act as a pressure intensifier specially at the end of the cylinder stroke. The main function of the equalizing valves is to remove any residual pressure when the cylinders get back to their original retracted position. Since the precision of the flow divider, specially when it works against different cylinder pressures, is not fine enough to keep platform level and synchronization within the desired limits, the equalizing valves are also used to correct the length of each cylinder. The cylinders found too long are drained to the reservoir until they are all back to the same length.

The other components of the hydraulic system include a 350 liter (90 US g) reservoir, filters, a pressure gage, a thermometer, etc.

Appendix A gives the schematic diagram, the parts list and all the technical specifications.

5.2

Electrical system

Electrical equipments are concentrated in the control box, the main junction box and the two level detectors. At the centre of the table there also are two synchronization switches and a limit switch which senses if the platform has reached the end of its down stroke.

The schematic diagram given in appendix B shows the whole system operating from the 12 volt battery of the diesel engine. This insures the autonomy of the system making it independant of power failure.

A key switch, installed on the main junction box on the hydraulic group, controls the feeding of all the circuits. More over, an emergency push button allows the operator to cut power directly from the control box. The wiring of the UP and DOWN push buttons makes it impossible to simultaneously energize both UP and DOWN valves.

The limit switch FC is closed when platform no 1 is less than a few centimeters from the base. This allows, when the platform goes back to its low position, to energize, through the time delay relay T1, the four equalizing valves for some 10 sec. to make sure all the cylinders retract completely.

Switches S1, S2, S3 and S4 close when platforms no 1 and no 2 are out of level. More precisely, when platform no 1 leans to the left (right) switch S1 (S2) closes; the equalizing valve EQ1 (EQ2) is energized and the cylinder no 1 (no 2) retracts until the platform is back to level. Switches S3 and S4 do the same for platform no 2. Switches S1A, S2A, S3A and S4A work in a similar way except they close only when the platforms lean more; they then sound the alarm and turn on the pilot lights corresponding to the cylinders which are too long. The dual stroke switches S5 and S6 work on the synchronization of the two platforms; S5 acts on the equalizing valves while S6 drives the alarm and the pilot lights when the difference between the two platforms gets too large. The alarm tells the operator to stop and the pilot lights indicate to him which cylinders are too long.

The schematic diagram, the list of components and the technical specifications are given in appendix B.

5.3

Weighing pads

Each weighing pad is mounted on four double ended shear beam load cells having a nominal capacity of 11 400 kg (25 000 lb). The cable from each load cell is rooted to a central junction box where the four cables are connected to a multi-pin connector. A 36 meter long cable, with connectors at each end, is included with each weighing pad to bring load cell signals to the measuring instruments.

The technical specifications of the load cells along with wiring information are given in appendix C.

5.4

Tilt table design

The design of the tilt table is explained in detail in the tilt table design manual (ref. 1).

REFERENCES

- 1- Bédard, Jean T., "Tilt Table - Design Manual", Transportation Development Centre, Transport Canada, TP 7523E, March 1986.
- 2- Bédard, Jean T., "Table de renversement - Manuel de conception", Transports Canada, Centre de développement des transports, TP 7523F, mars 1986.
- 3- Bédard, Jean T., "Table de renversement - Manuel de l'utilisateur", Transports Canada, Centre de développement des transports, TP 7522F, mars 1986.

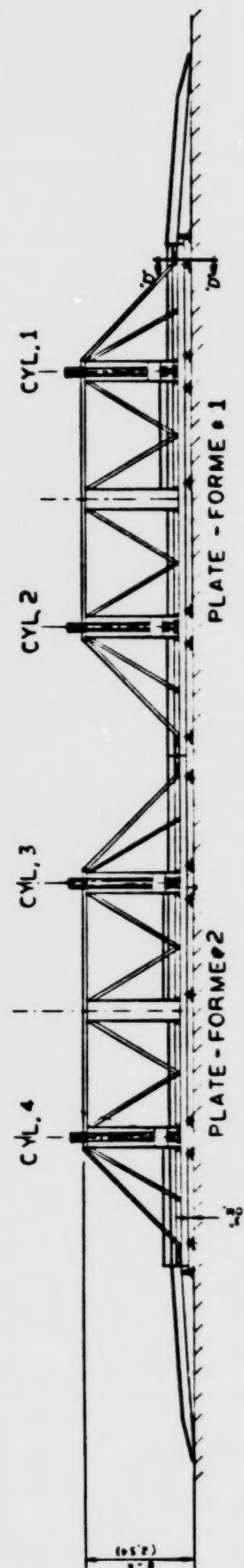


FIGURE 1: Tilt table general assembly

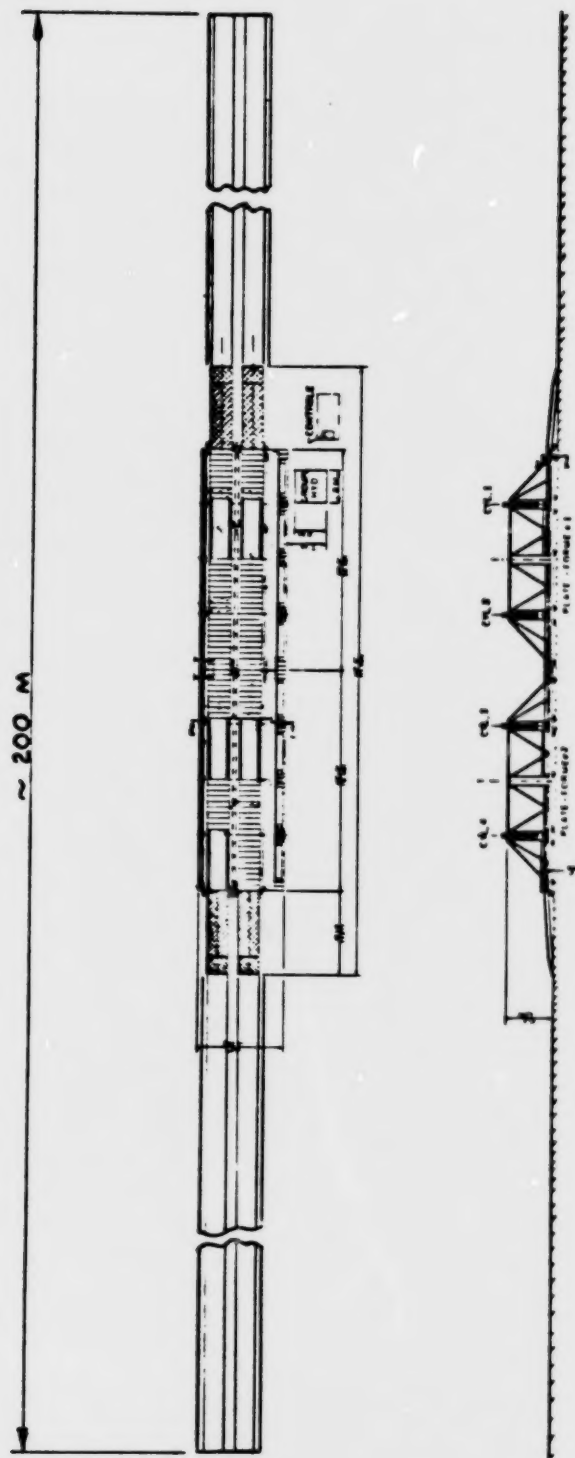


FIGURE 2: Typical installation of the tilt table

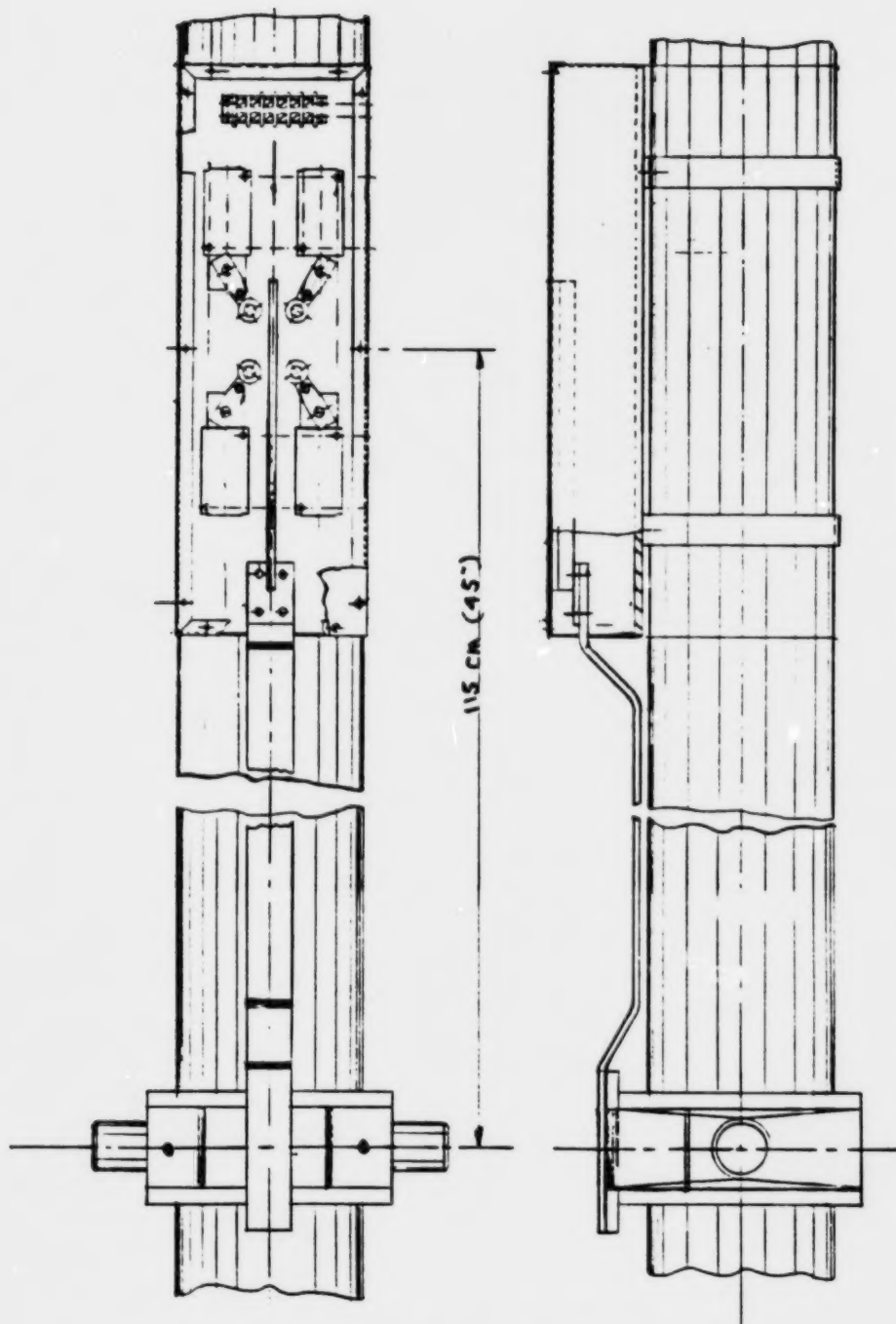


FIGURE 3: Installation of the platform level detectors

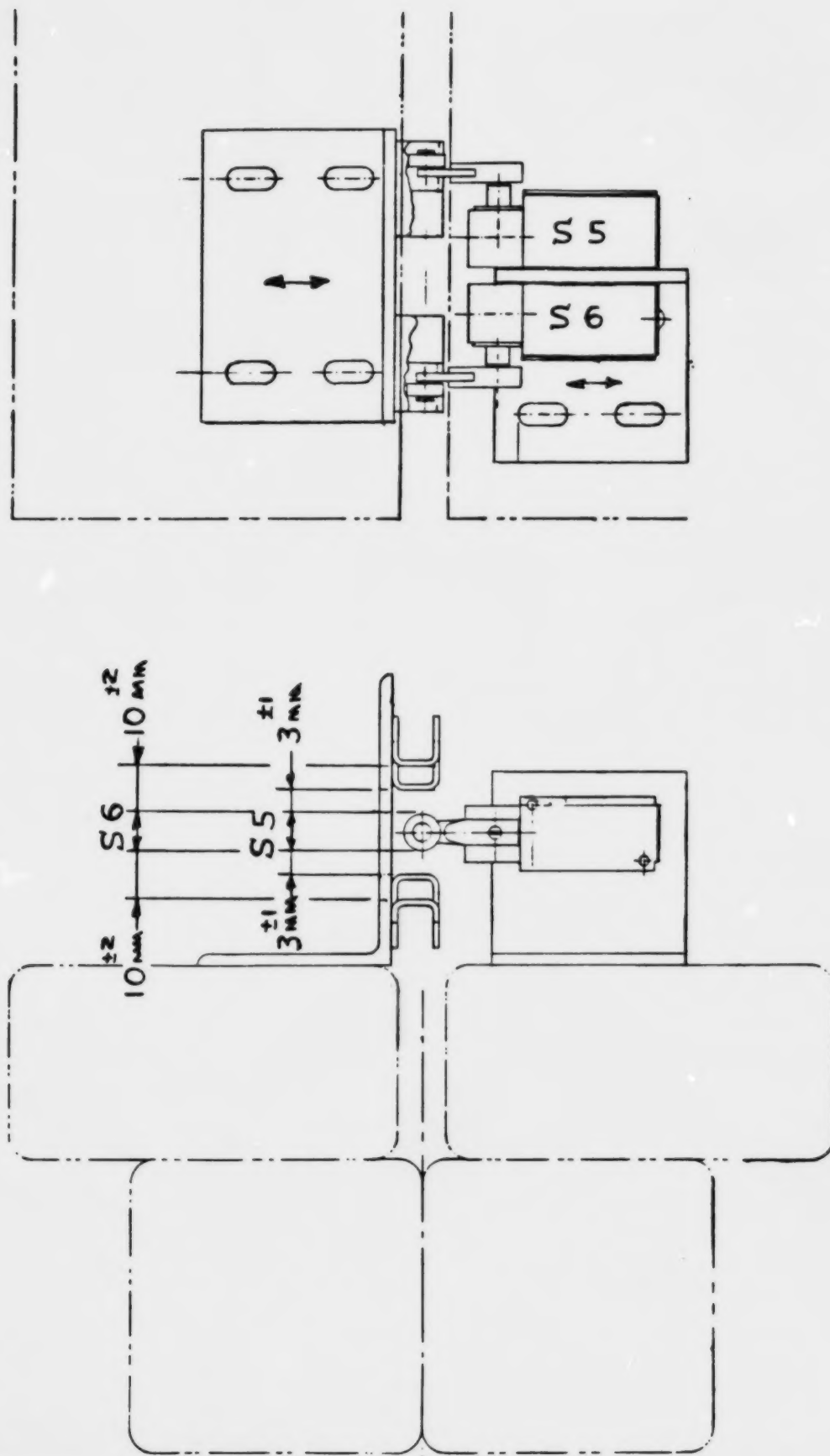


FIGURE 4: Installation of the platform synchronization switches

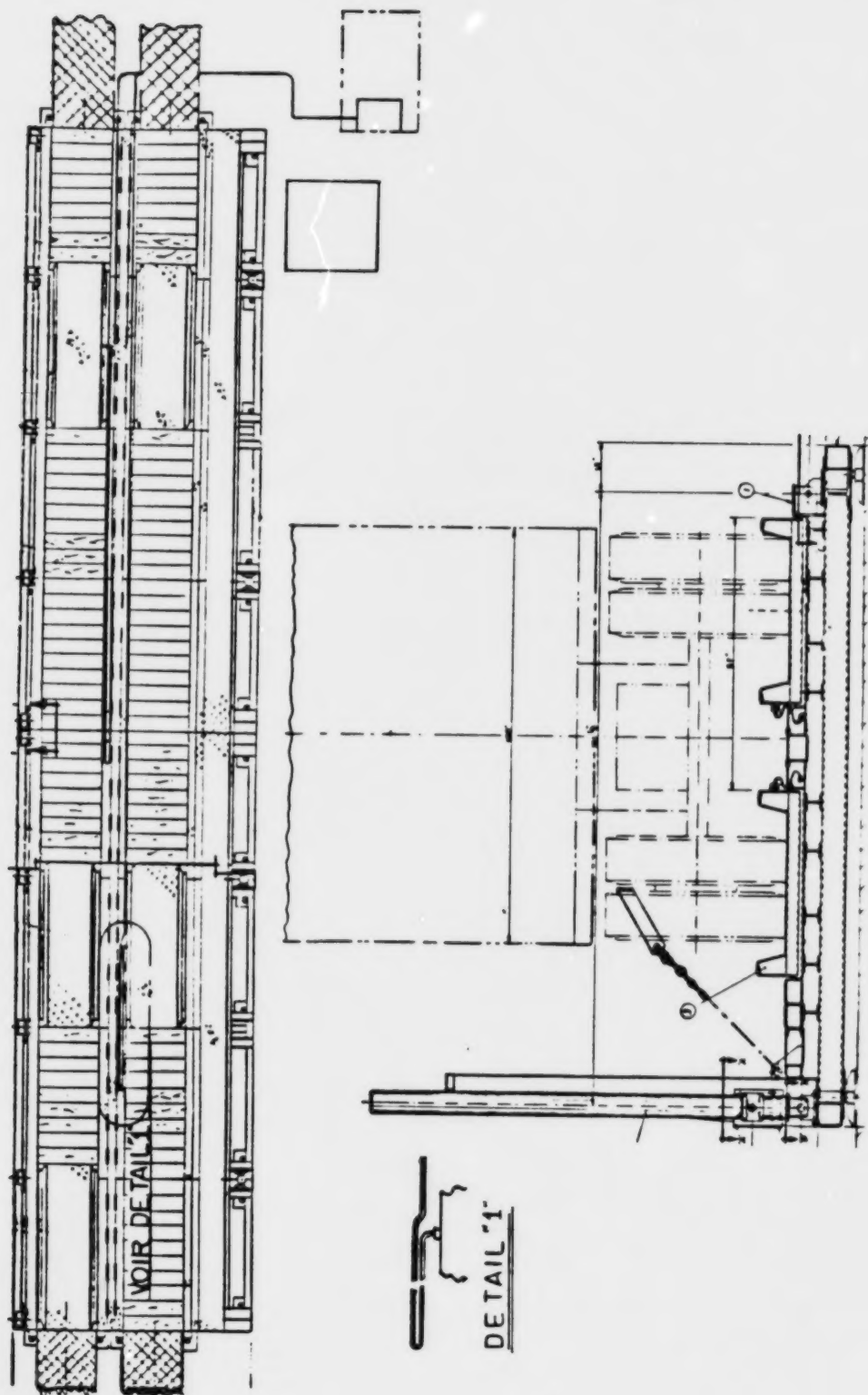


FIGURE 5: Installation of the weighing pads

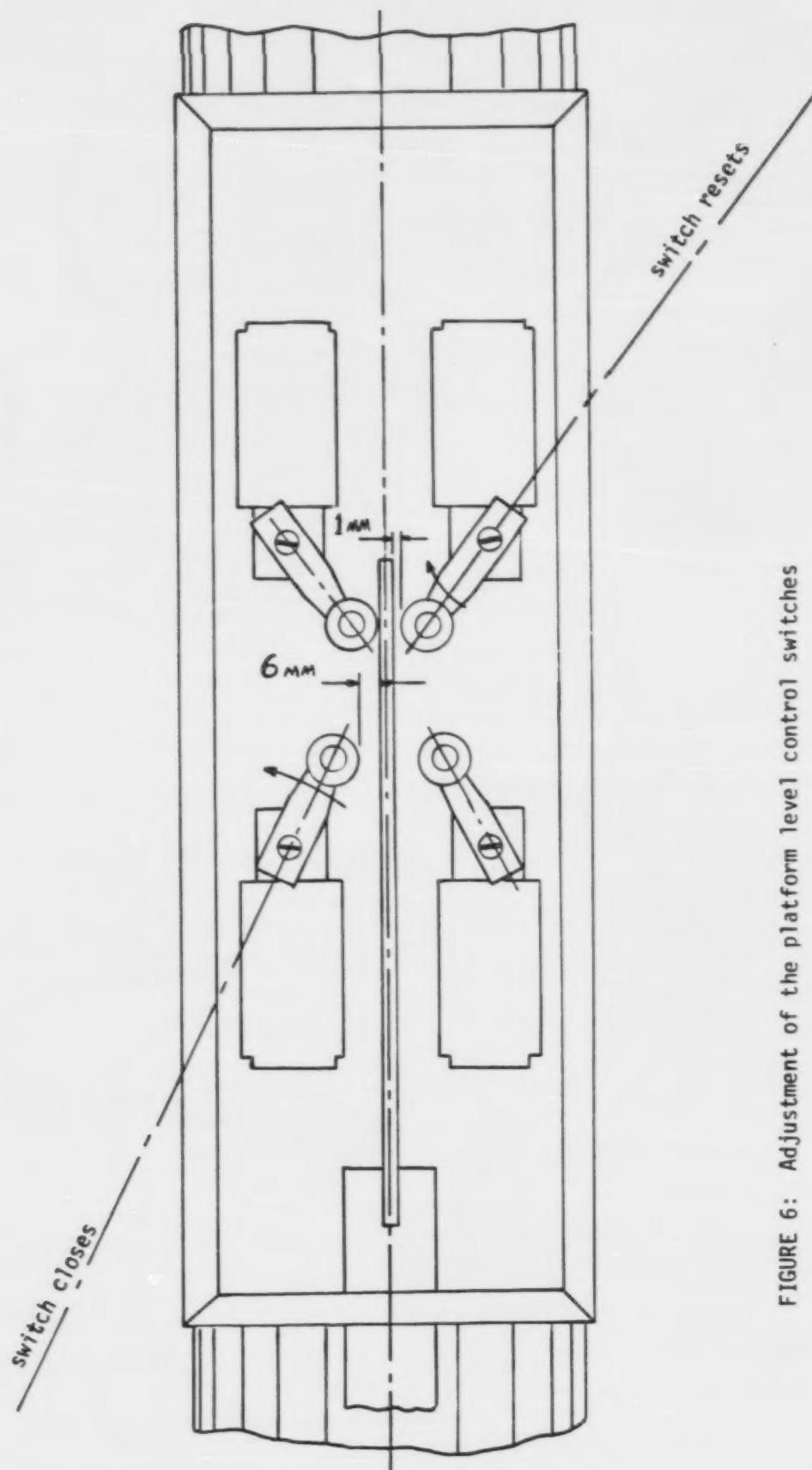


FIGURE 6: Adjustment of the platform level control switches

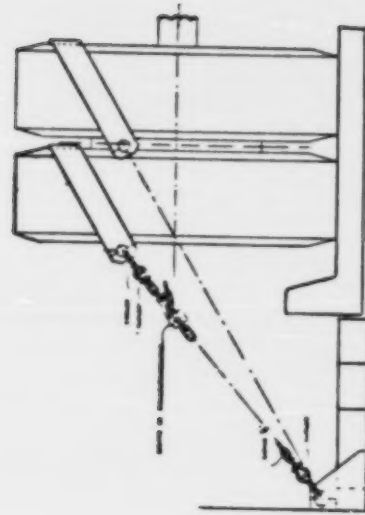
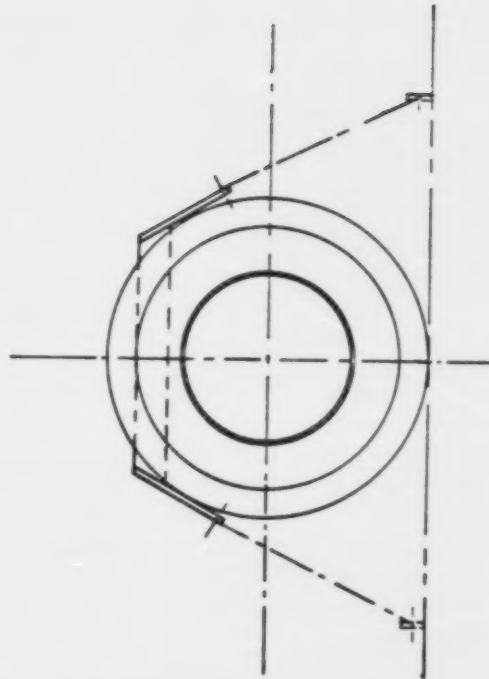
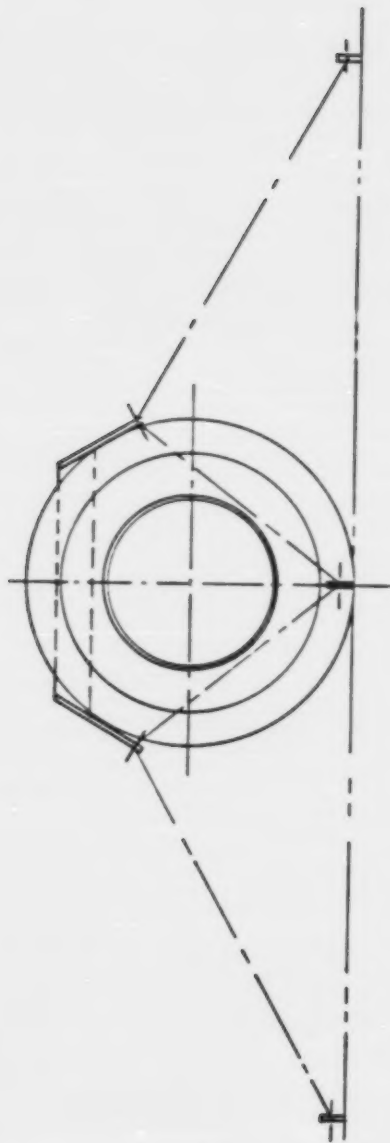


FIGURE 7: Installation of the vehicle wheel restraint system

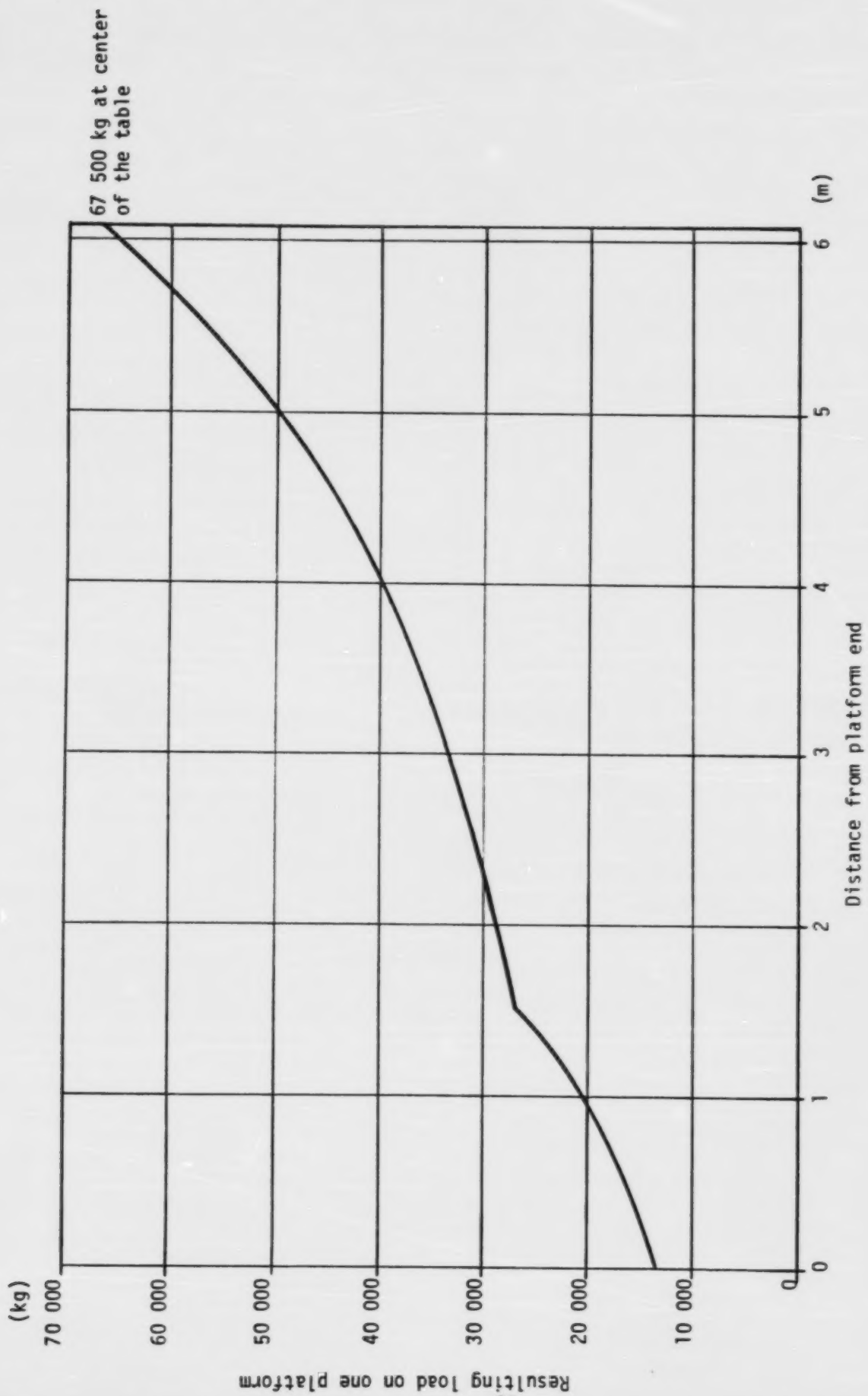
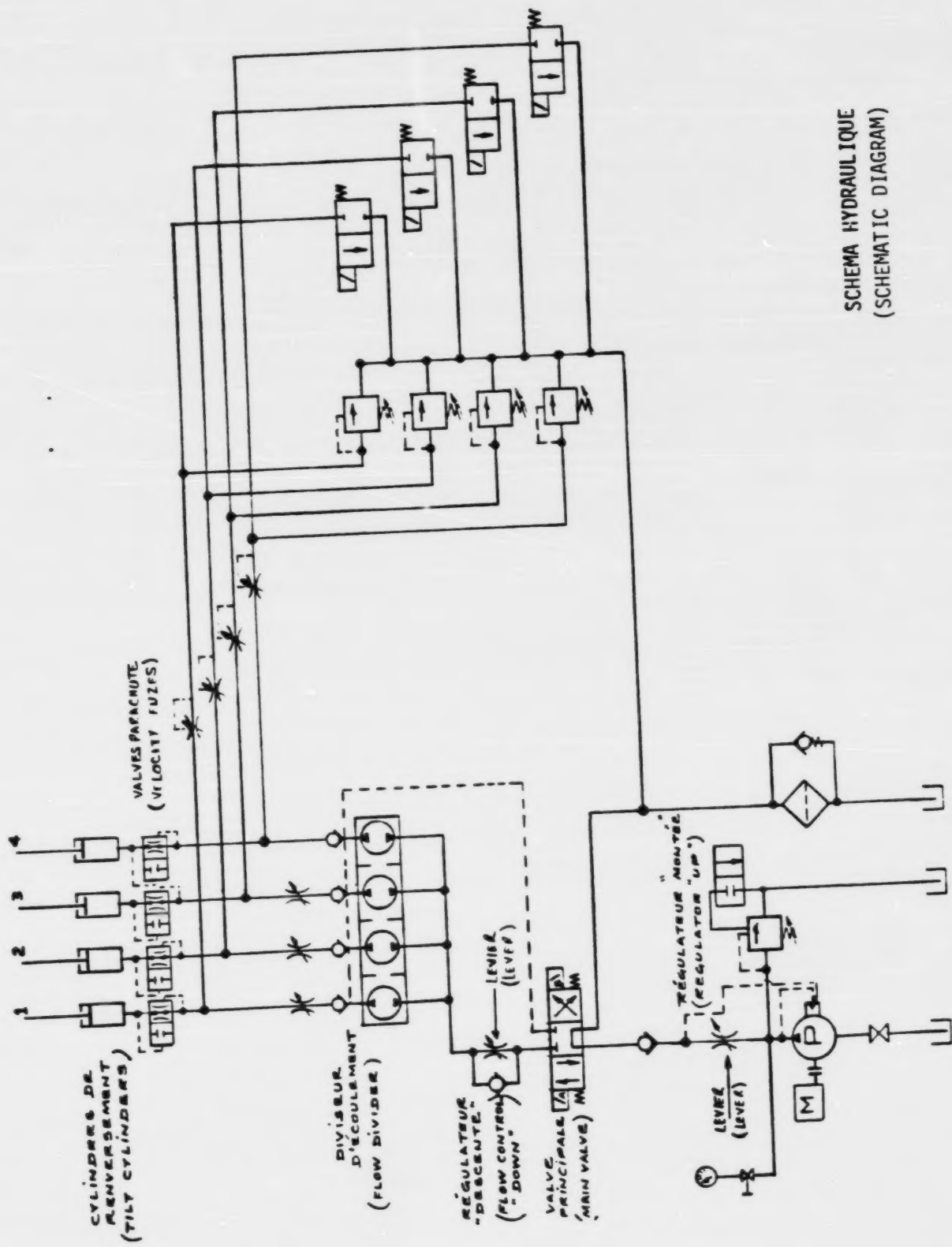


FIGURE 8: Maximum resulting load on one platform according to its position.

APPENDIX A

Hydraulic system

- Schematic diagram
- Parts list
- Technical specifications



SCHEMA HYDRAULIQUE
(SCHEMATIC DIAGRAM)



LES ENTREPRISES SHP LTÉE

NOMENCLATURE

SHP 16197 F

MACHINE

Table de Renversement

DATE April 15/85

PAGE 1 DE 3

MACHINE

Table de Renversement

DATE April 15/85

PAGE 1 DE 3

OTÉ 1

TITRE

Groupe Hydraulique

DESSIN

B-9171

PROJET 5878

ITEM	OTÉ.	DESCRIPTION	V	MARQUE	P. O.	RECEP. PRÉVUE
1		Réservoir 350 l avec base moteur Diesel et réservoir pour caburant Diesel		REXROTH	12154	
1		152114 Porte de visite		REXROTH	"	
1		70-105 Valve de vidange		APOLLO	"	
1		ELF3-10/1.0 Reniflard		HYCON	"	
1		FSA127-1.0/T Indicateur de niveau		HYCON	"	
1		RFBN240G10B1.1/5 Filtre de retour		HYCON	"	
1		2222-BL Valve d'isolement aspiration		JENKINS	"	
1		1.767.379 Manomètre 0-3000 PSI		V.D.O.	"	
1		DV8-1.0/5PS Valve d'isolement		HYCON	"	
1		A10V63DR1R14 Pompe à pistons		REXROTH	12153	
1		2722E Moteur Diesel 61/72HP-22T/MN		FORD	12162	
1		DP01-3-11C2 Boite d'entraînement		MARCO	12163	
1		1AR13-F6-40S Valve de sécurité		FLUID CONTROLS	12308	
1		KHB10(3/8")-1-1-1-2 Valve boisseau sphérique		HYCON	STK	
1		S310MC1968 Bloc contrôle de vitesse et de charge avec :		SHP	12139	
1		2F76-L6-6-25S Contrôle de débit		FLUID CONTROLS	STK	
1		RV20-1.0/5 Clapet anti-retour		HYCON	12313	



LES ENTREPRISES SHP LTÉE

NOMENCLATURE

SHP 16197 F

MACHINE

Table de Renversment

DATE April 15/85 PAR

PAGE 3 DE 3

PROJET 5878

QTÉ

TITRE

Matériel Auxiliaire

DESSIN B-9171

DESCRIPTION

QTÉ.

V

MARQUE

P.O.

RECEP.
PREVUE

4 Vérin simple effet. 5" alésage x 93" course

4 28001-506-8 Valve parachute

2 MA-300137 Station de commande

2 38012-003-0240-20" Cables flexibles avec attaches

LESSARD

VAN BERG

MORSE

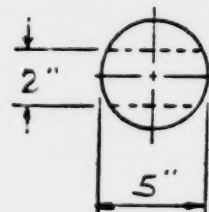
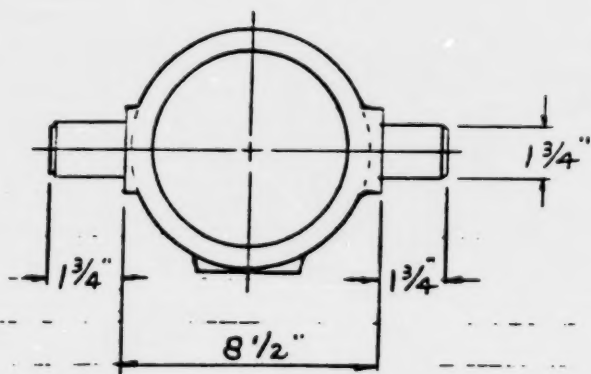
MORSE

PAR
CLIENT

12155

12232

12232


$$\frac{2,000 \text{ LBS PD/CA}}{\text{Psi}}$$

			 C. P. 38 St-Wenceslas, Co. Nicolet, Qud.	<u>PAR</u> <i>RA</i>	<u>DATE</u> <i>1 fév 85</i>
				<u>DESSIN</u> <i>NC</i>	<u>RE:</u>
<i>1</i>	<i>475</i>	<i>CLASSE ETAT 105th</i>		<i>85-104</i>	

REXROTH

WORLDWIDE HYDRAULICS

MOBILE HYDRAULICS DIVISION

1700 Old Mansfield Rd

P.O. Box 394 Wooster, OH 44691

216/262 2010 Telex: 98-5335

INDUSTRIAL HYDRAULICS DIVISION

2315 City Line Rd

P.O. Box 2407 Bethlehem, Pa. 18018

215/694-8300 Telex: 84-7498

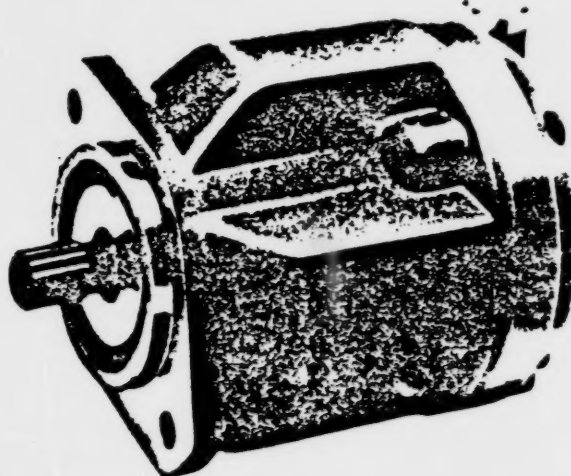
VARIABLE DISPLACEMENT PUMP, TYPE A10V
Mobile Design For Open Circuits
Axial Piston, Swashplate Design**RA**
92700

Sizes 25 to 63

Up to 3600 psi

1.52 to 3.84 in³/rev.

Issue Date: 6/83

**Description**

The A10V is a swashplate design, variable displacement pump designed for open circuit, medium pressure applications. The flow output is proportional to the drive speed and swashplate angle.

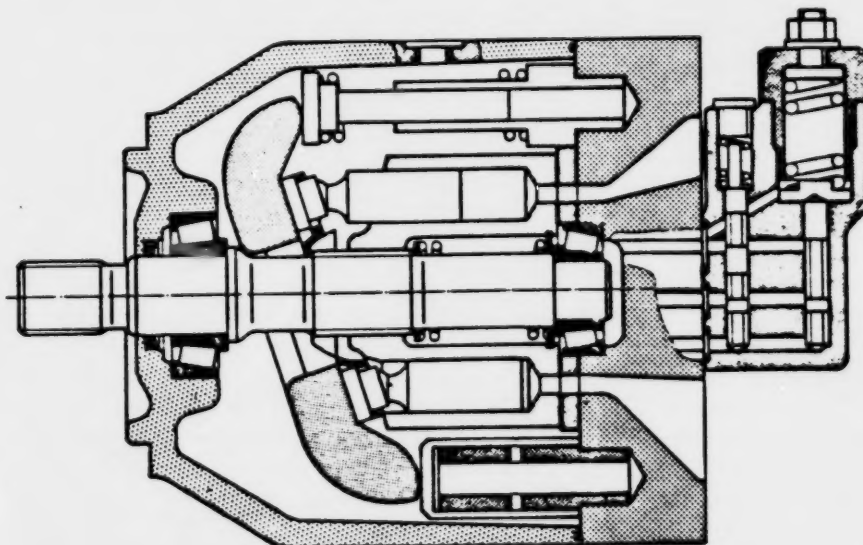
The A10V is available with controls for open circuit applications with closed-center valves.

Pressure compensator
Pressure & flow compensator (load sensing)
Constant HP Control

Features

- 2-bolt mounting flange and splined shaft to SAE J744
- SAE flange port connections with UNC bolt holes

- good suction characteristics
- peak pressure 3600 psi
- low noise level
- long service life
- axial and radial loading of drive shaft is permitted
- high power/weight ratio
- aluminum housing
- fast response times
- operation with mineral oil
- through drive for combination pumps

Construction**REXROTH**
WORLDWIDE HYDRAULICS

TYPE CODE

Model Variable displacement piston pump for open circuit applications, mobile design A10V		Size In ³ /rev. (cm ³ /rev.) 1.52 (25) 25 2.44 (40) 40 3.85 (63) 63		Controls Pressure compensator DR Flow & pressure compensator (load sensing) DFR Constant HP-control (in preparation) LR		Design Series No. Series 1		Additional Information In clear text Port Configurations SAE 4-bolt flange, rear facing 2 SAE 4-bolt flange, side facing 4 SAE 4-bolt flange, side facing with through drive 6 Mount And Drive Shaft Configurations SAE 2-bolt flange and SAE splined shaft 1 Direction of Rotation As viewed at shaft end Clockwise R Counter-clockwise L	
--	--	--	--	---	--	--------------------------------------	--	---	--

Type Code Example

A10V40DFR1R12
 Variable displacement pump, type A10V, size 40, with flow and pressure compensator control, design series 1, clockwise rotation, S.A.E. splined shaft, S.A.E. 4-bolt flange, rear facing.

Mounting Position

Optional, ensure that pump housing is always filled with the fluid used in the system.

Installation

The A10V may be face mounted to a drive gearbox or P.T.O. for mobile applications, or to standard foot mounting brackets.

The case drain line should be connected to the case drain port L, and run back to the reservoir in such a manner that the pump case always remains full of fluid.

Filtration

A return line filter having an element with a nominal rating of 10 microns or less is recommended. The reservoir and reservoir accessories should be designed to prevent ingestion of contaminants into the reservoir.

If a suction filter is used, the nominal rating should also be 10 microns or less, and the filter should be sized so that a minimum inlet pressure of -3 psig (0.8 bar absolute) or better is maintained.

Fluid Viscosity Ranges

The hydraulic fluid selected should operate within the following viscosity ranges.

Maximum viscosity at start-up	4600 SSU (1000 mm ² /sec)
Normal operating viscosity range	66-464 SSU (12-100 mm ² /sec)
Optimum viscosity range	81-141 SSU (16-30 mm ² /sec)
Minimum viscosity	60 SSU (10 mm ² /sec)

Fluid Temperature Range

-13°F to +176°F (-25° to +80°C)

The fluid temperature level of a particular system is normally measured at the pump or motor case drain. This temperature is then used to establish the cooling requirements for the system.

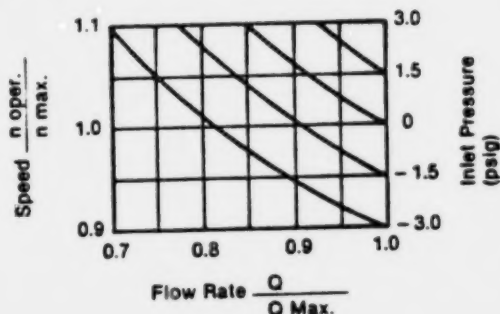
TECHNICAL DETAILS

GENERAL SPECIFICATIONS A10V PUMP				
Specification	Unit	A10V25	A10V40	A10V63
Displacement	in ³ /rev	1.52	2.44	3.84
	cm ³ /rev	25	40	63
Nominal flow at 1000 rpm	gpm	6.6	10.5	16.6
	l/min	25	40	63
Torque constant (theoretical)	lb ft/100 psi	2.01	3.23	5.09
	Nm/bar	0.39	0.64	1.00
Maximum Inlet pressure, -3.0 psig	rpm	3000	2500	2200
drive speeds Inlet pressure, 0 to 215 psig	rpm	3250	2800	2400
Rated pressure (continuous)	psi	3000	3000	3000
	bar	207	207	207
Peak pressure (intermittent)	psi	3625	3625	3625
	bar	250	250	250
Minimum Operating Pressure	psi	75	75	75
	bar	5	5	5
Minimum inlet pressure at suction port 'S'	psig	-3.0	-3.0	-3.0
	bar	-0.8	-0.8	-0.8
Maximum inlet pressure at suction port 'S'	psig	215	215	215
	bar	15	15	15
Weight (dry)	lbs	24.2	33.0	55.0
	Kg	11.0	15.0	25.0
Filling capacity of pump case	in ³	43	61	97
	liter	0.7	1.0	1.6
Maximum permissible external loading of the drive shaft	F _A lbs	225	337	540
	N	1000	1500	2400
	F _R lbs	540	810	1350
	N	2400	3600	6000

*The above specifications & performance details are assuming the use of a good quality petroleum based hydraulic fluid. Use of synthetic fluids and water/oil emulsions is possible with derated specifications and performance. Contact Rexroth for details.

Pump Drive Speed

The following chart details the maximum drive speed in relation to inlet pressure (at suction port "S") and pump output flow.



Maximum Allowable Case Pressure
(Measured at case drain port L) 7.25 psi (0.5 bar) above inlet pressure (at suction port "S") but not more than 29 psig (2 bar)

Start-Up

The pump case must be filled with the hydraulic fluid used in the system.

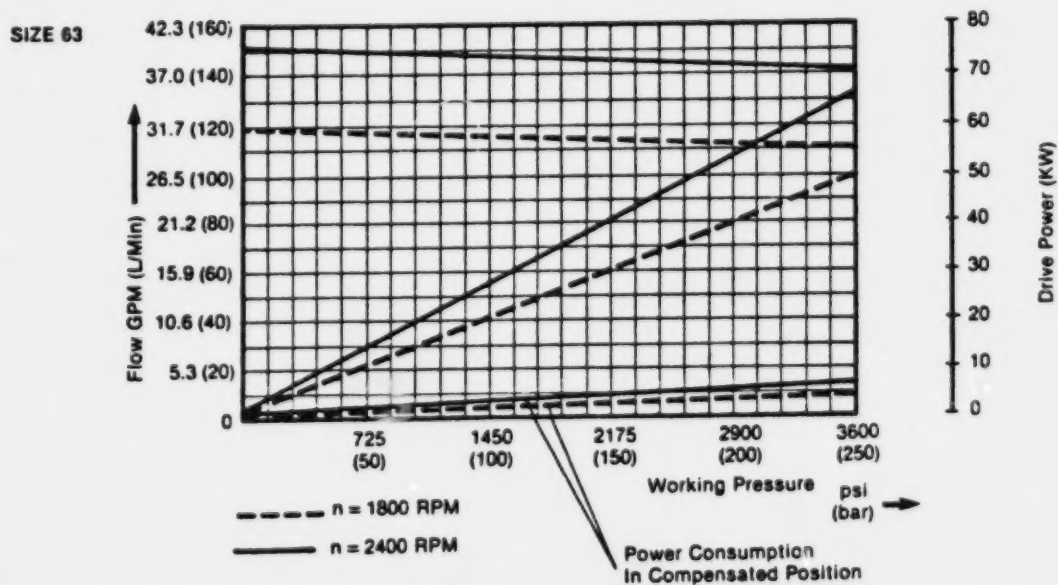
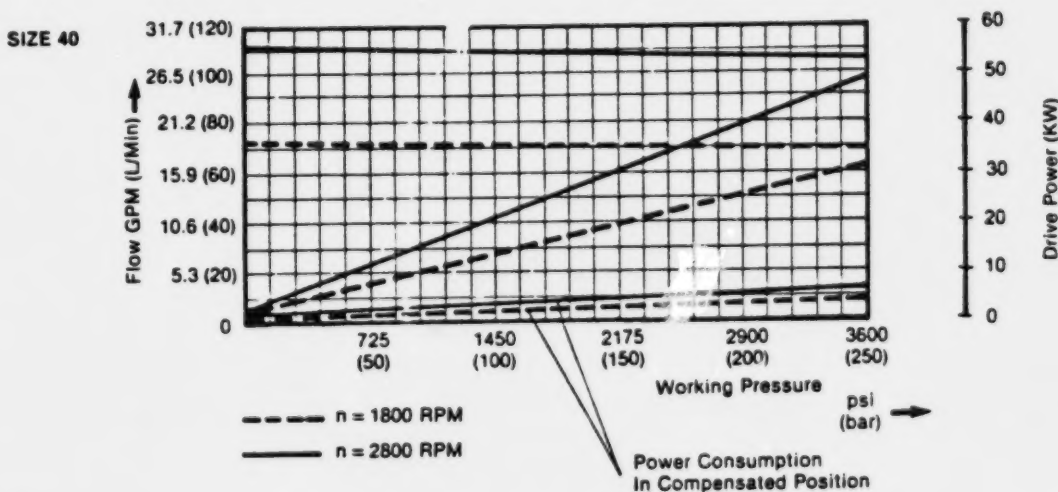
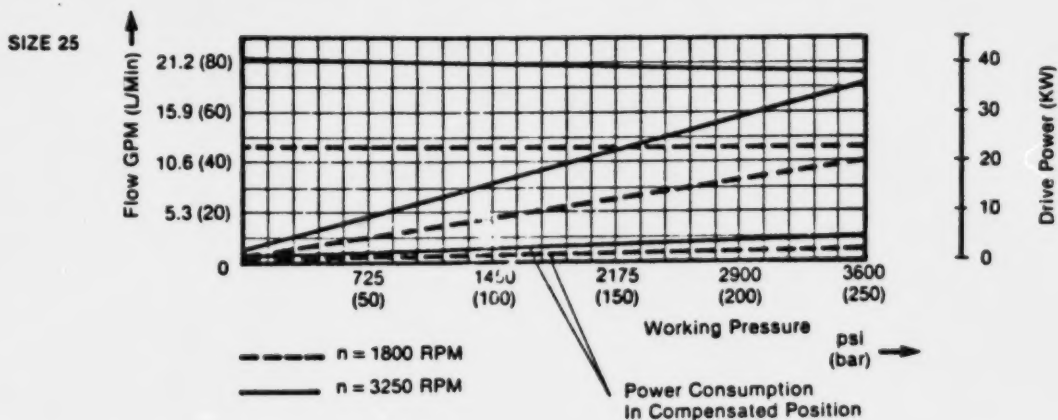
Before starting, allow the pump to discharge directly to the reservoir (open center circuit) with lowest possible pressure drop.

Prior to running the pump at full speed, the drive should be jogged until fluid begins to flow from the line returning to the reservoir. With the circuit still in the "open center" mode, run the pump at design speed until a steady flow is obtained from the line returning to the reservoir. Remove the open center (short circuit) and operate the pump in the normal closed center mode.

Some applications may require a slight departure from the above procedure.

PERFORMANCE CHARACTERISTICS

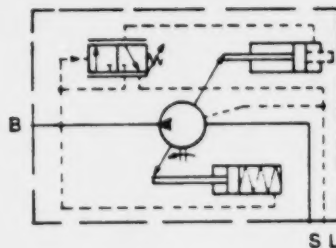
(MINERAL OIL)
DRIVE POWER AND FLOW OUTPUT



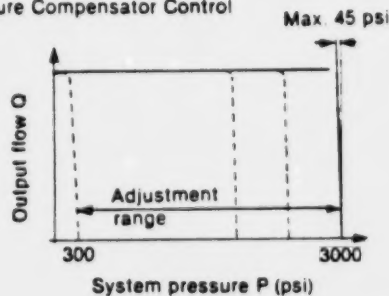
CONTROL DESCRIPTIONS (Description for Constant HP-Control in Preparation)

Pressure Compensator, Type DR

The pressure compensator control gives maximum output flow to the system until the system reaches the pre-adjusted pressure setting of the control. The pressure compensator control then regulates the pump output flow to equal the flow requirements of the system while maintaining the pre-adjusted output pressure. When the system no longer requires flow, the pressure compensator control will cause the pump to destroke so that there is no output flow while maintaining the pre-adjusted pressure.

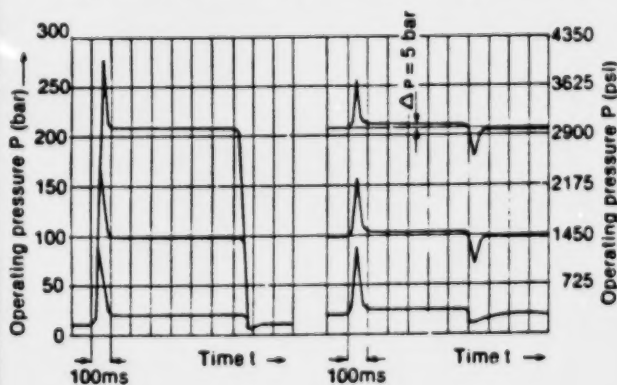


Control characteristics—
Pressure Compensator Control



Dynamic Characteristics of the Pressure Compensator Control (DR)

measured with 2/2-way valve; without pressure relief valve
(pipe between pump and valve 400 mm long, 20 mm dia.)

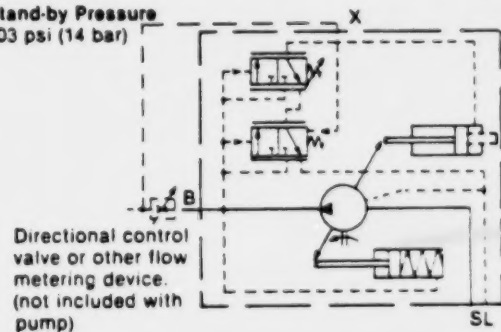


Flow & Pressure Compensator, Type DFR

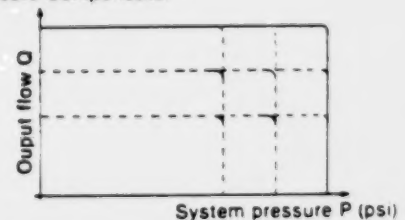
The flow and pressure compensator control, also known as a load-sensing control, matches pump output flow and pressure to system demand. This control will automatically regulate the pump displacement to deliver the flow required to maintain a constant pressure drop across a valve spool or other flow limiting device. When there is no system demand, the pump stands by at zero flow and low pressure. When the system demands flow, the pump delivers only the flow required by the system, at a pressure required to move the load.

To protect the system from infinite load pressures, the pressure compensator section of the control will cause the pump to automatically destroke when the pre-adjusted maximum system pressure is reached.

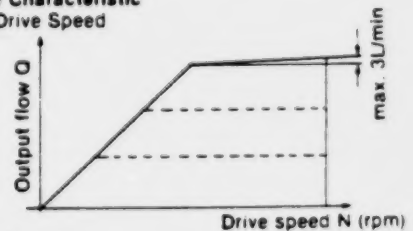
Stand-by Pressure 203 psi (14 bar)



Control characteristics—
Flow and Pressure Compensator

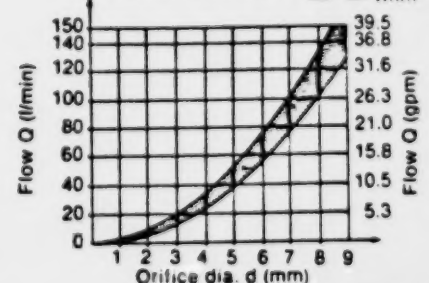


Constant Flow Characteristic with Variable Drive Speed



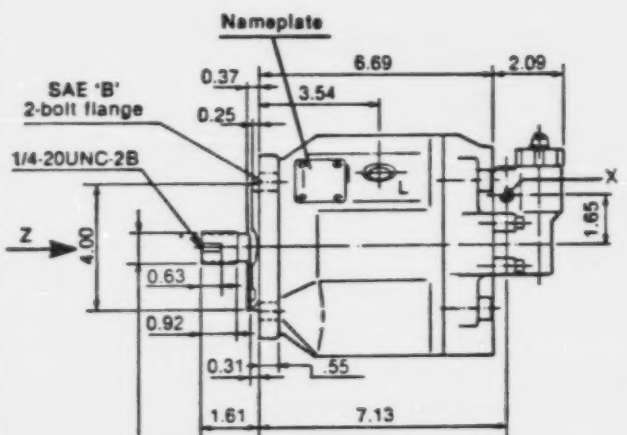
Orifice Selection

for constant
flow control (FR)
pressure drop across
the orifice $\Delta p = 203$ psi

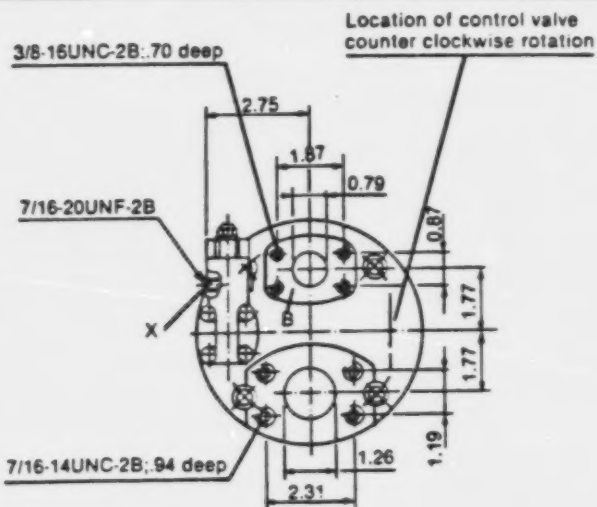


INSTALLATION DIMENSIONS A10V25

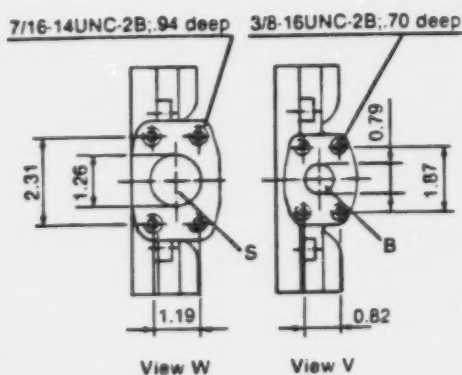
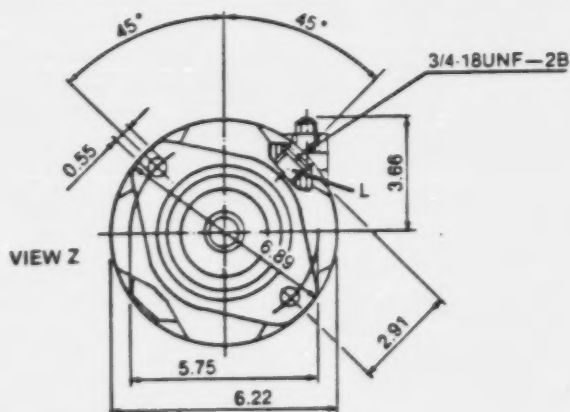
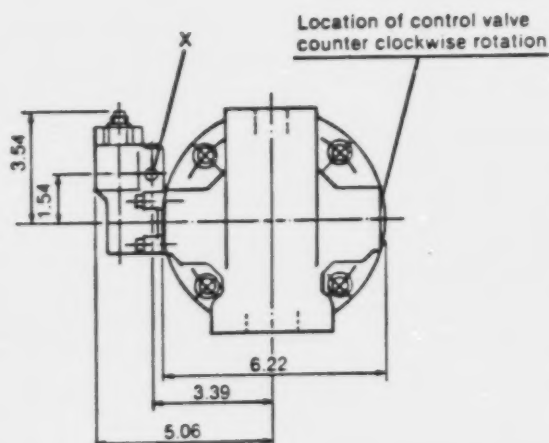
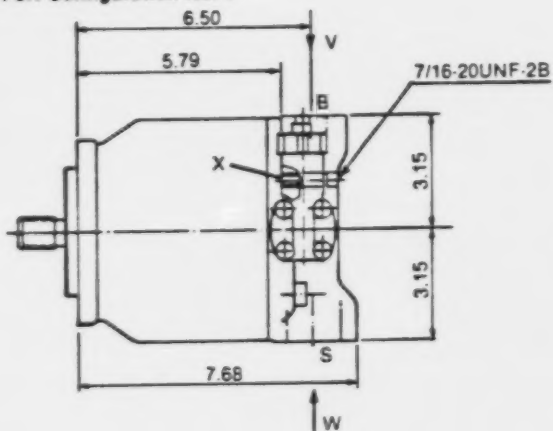
Direction of Rotation: Clockwise
Port Configuration No. 2



7/8 DIA. 13 TEETH, 16/32 D.P., 30° INVOLUTE,
FLAT ROOT, CLASS I SIDE FIT SPLINE (SAE J498b)



Port Configuration No. 4

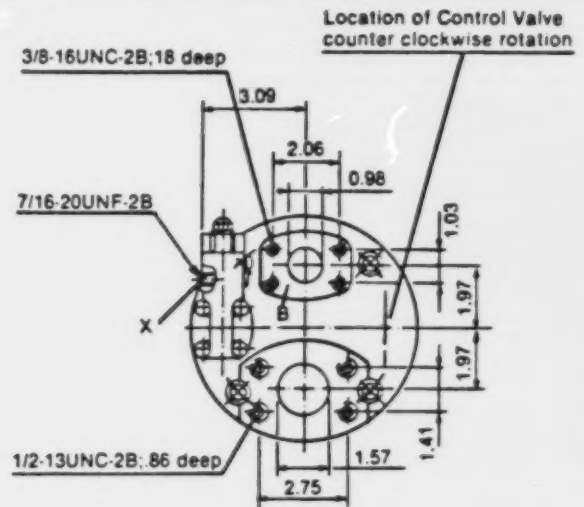
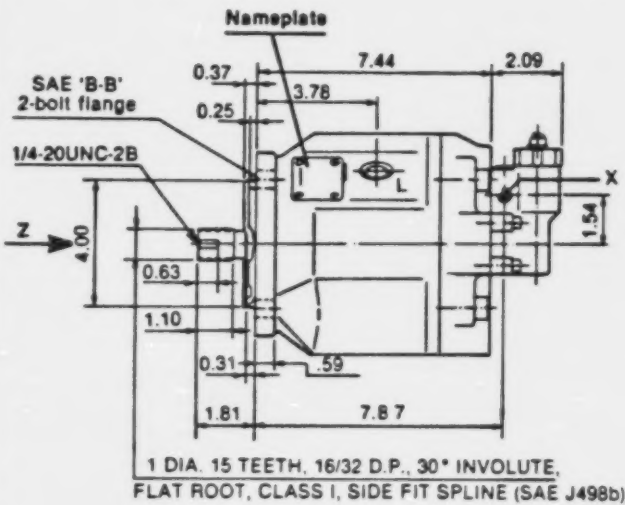


Port Connections

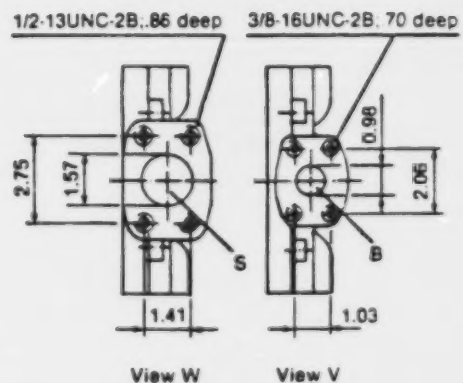
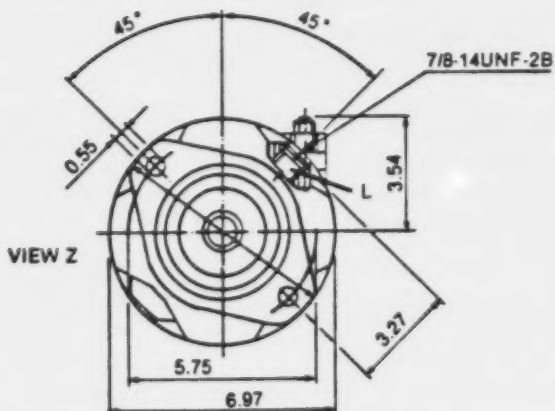
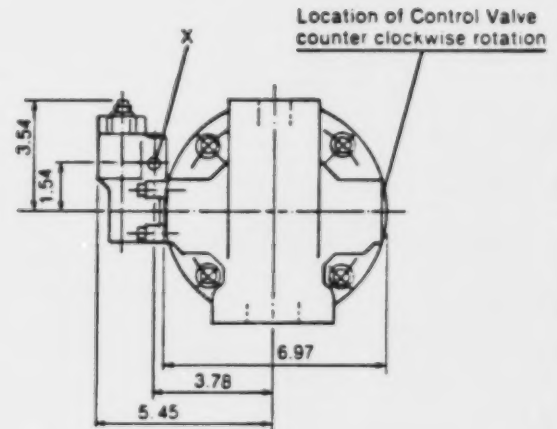
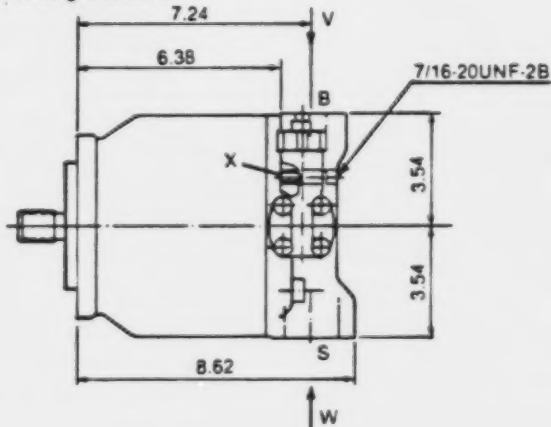
B = High Pressure Work Port SAE 1/4" - 3000 psi
S = Suction Port SAE 1 1/4" - 3000 psi
X = Load Sensing Pilot Port
L = Case drain port

INSTALLATION DIMENSIONS A10V40

Direction of Rotation: Clockwise
Port Configuration No. 2



Port Configuration No. 4

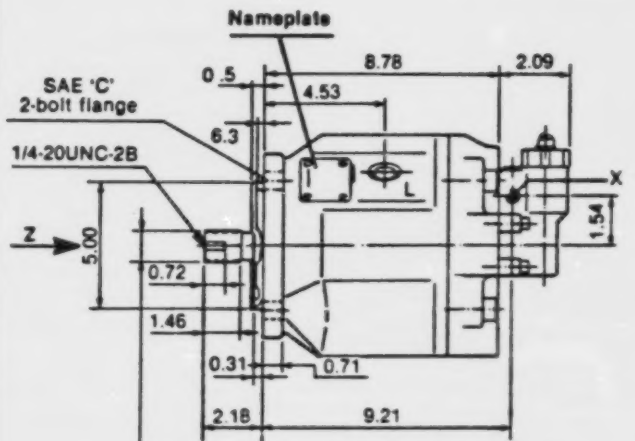


Port Connections

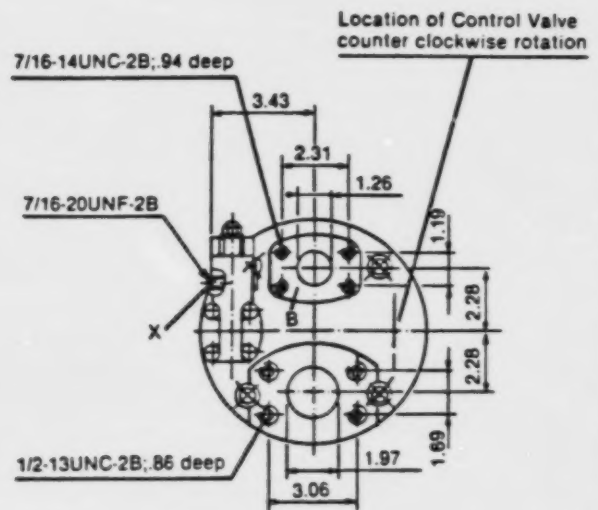
B = High Pressure Work Port SAE 1" - 3000 psi
S = Suction Port SAE 1 1/2" - 3000 psi
X = Load Sensing Pilot Port
L = Case Drain Port

INSTALLATION DIMENSIONS A10V63

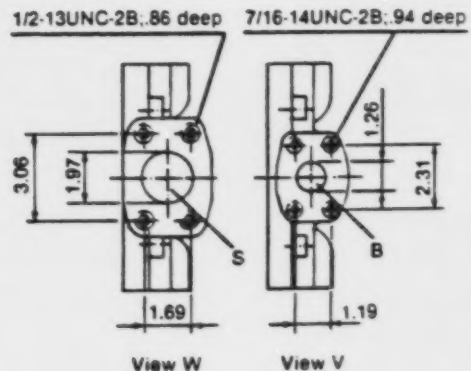
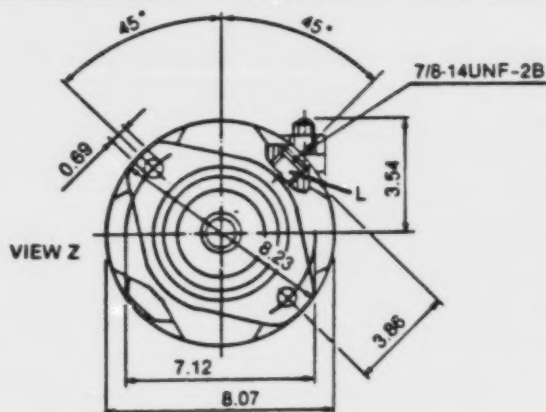
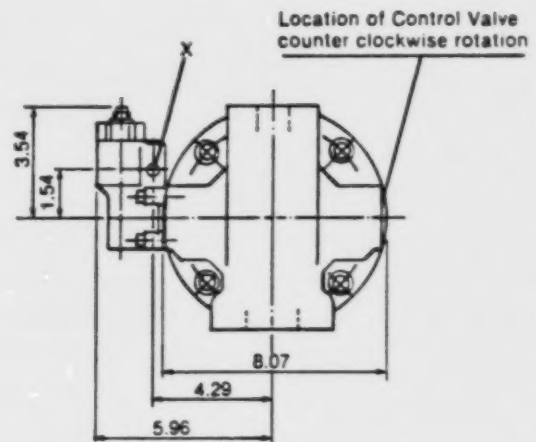
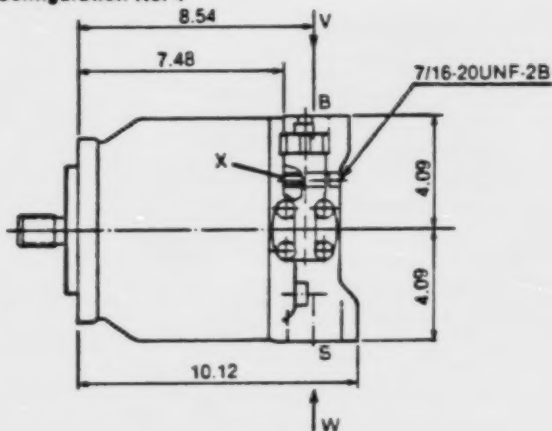
Direction of Rotation: Clockwise
Port Configuration No. 2



1 1/4 DIA. 14 TEETH, 12/24 D.P., 30° INVOLUTE,
FLAT ROOT, CLASS I, SIDE FIT SPLINE (SAE J498b)



Port Configuration No. 4



Port Connections

B = High Pressure Work Port SAE 1 1/4" - 3000 psi
S = Suction Port SAE 2" - 3000 psi
X = Load Sensing Pilot Port
L = Case Drain Port

TANDEM PUMPS AND THROUGH DRIVES

Description

The A10V open circuit piston pumps can be combined to form tandem open circuit piston pumps, or a combination of open circuit piston pump plus a Rexroth S15S, S20S, or S30S gear pump.

Available Combinations

Basic Pump +	Piston Pump			Gear Pumps*		
	A10V25	A10V40	A10V63	S15S	S20S	S30S
A10V25	•			O	•	•
A10V40	•	•		O	•	•
A10V63	•	•	•	O	•	•

O SAE A 2-bolt through drive is in preparation.

* Refer to technical data sheets

RA 64756 (S15S) RA 64783 (SVP20)

RA 64774 (S20S) RA 64789 (S30S)

It is recommended not to stack more than three pumps in one combination, i.e. 2x A10V piston pumps plus 1x gear pump.

Type Codes

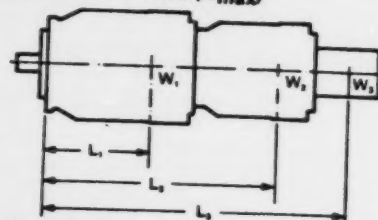
The type code for an A10V tandem or A10V + gear combination pump is derived by listing the type code of the basic pump (with number 6 port plate), a plus symbol (+), and the type code of the second piston or gear pump.

Example: A10V63DR1R16 + A10V40DR1R14

If only a through drive is required on an A10V piston pump (no second pump), the type code of the A10V is listed with the through drive size given in clear text.

Example: A10V63DR1R16/SAE B-B

Allowable Moment of Force (M_{max})



$$M_{max} = (W_1 \times L_1) + (W_2 \times L_2) + (W_3 \times L_3)$$

SIZE		25	40	63	
Allowable Moment of Force	M _{max}	lb-ft	65	101	159
		kgm	9	14	22
Weight	W,	lb	24.2	33.0	55.0
		kg	11	15	25
Distance to center of gravity	L,	in	4.33	5.12	5.91
		mm	110	130	150

For weights of S15, S20 & S30 gear pumps, see relevant RA data sheet.

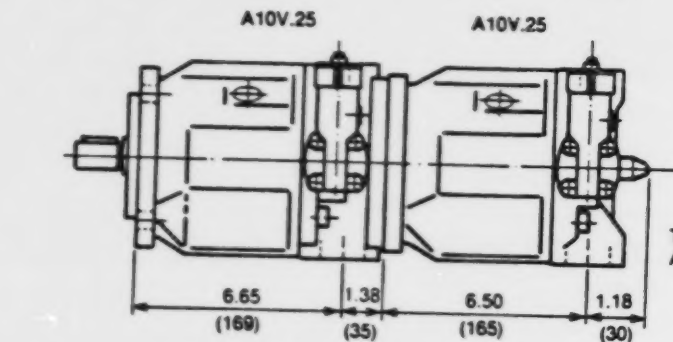
Allowable Through-Drive Torque

Size		25	40	63
Maximum allowable through-drive torque	T	lb-ft 66.5	103	166
		Nm 90	140	225

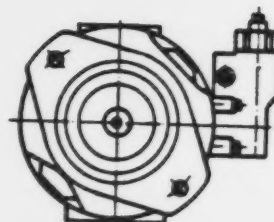
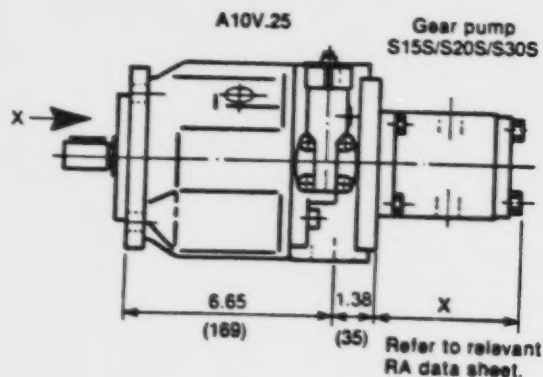
Note: For three pump combinations, the total torque requirement of the second and third pumps must not exceed the maximum permissible through-drive torque of the basic A10V piston pump.

Installation Dimensions

Tandem & Combination pumps with A10V25 basic pump.



Type code
A10V.25 .1. .1.6 + A10V.25 .1. .1..



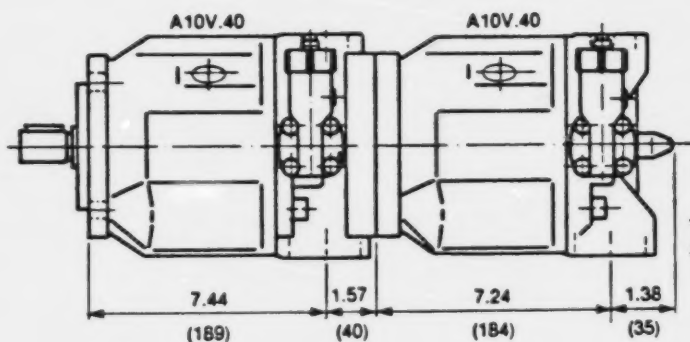
View X

Type code
A10V.25 .1. .1.6 + S15S

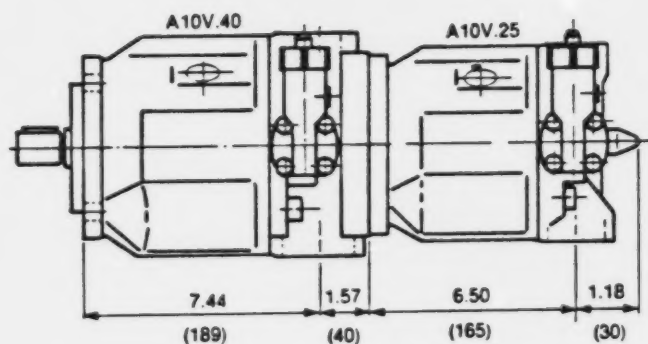
TANDEM AND COMBINATION PUMPS

Installation Dimensions

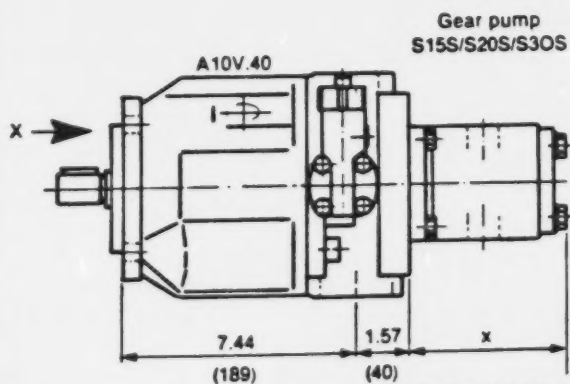
Tandem & combination pumps with A10V40 basic pump.



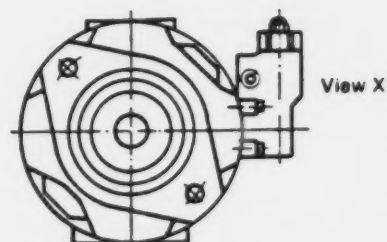
Type code
A10V.40. .1. .1.6 + A10V.40. .1. .1..



Type code
A10V.40. .1. .1.6 + A10V.25 .1. .1..



Refer to relevant
RA data sheet

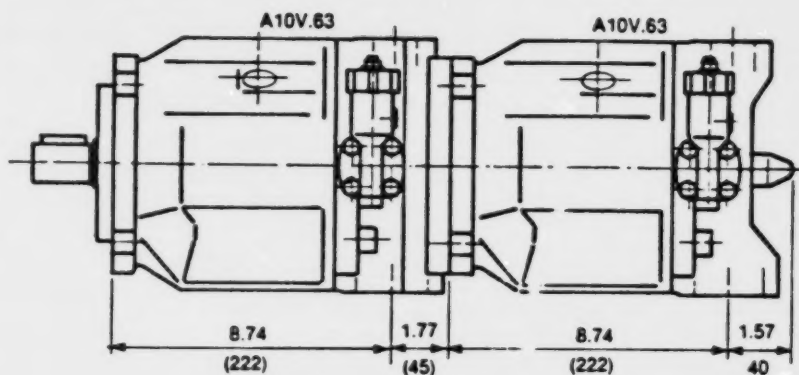


Type code
A10V.40. .1. .1.6 + S15S

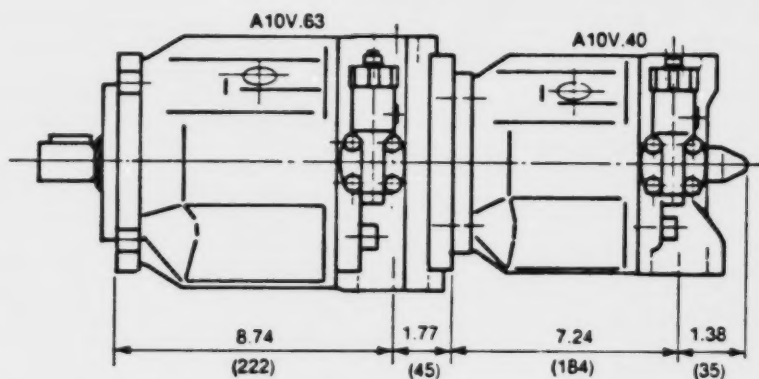
TANDEM AND COMBINATION PUMPS

Installation Dimensions

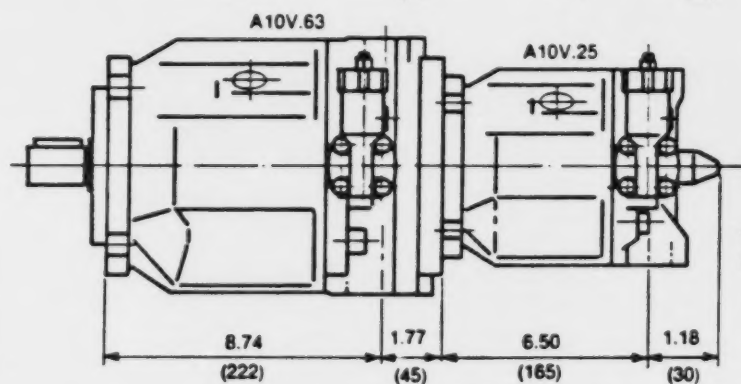
Tandem & combination pumps with A10V63 basic pump



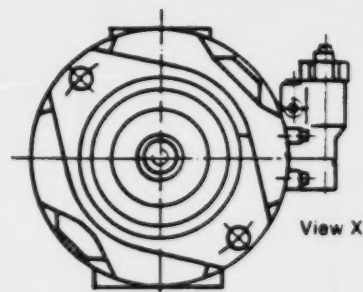
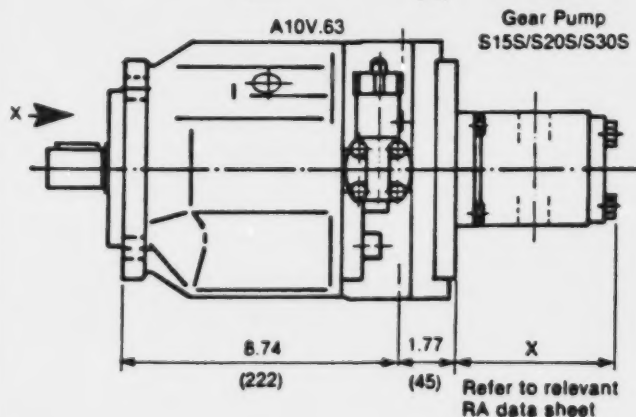
Type code
A10V.63..1..1.6 + A10V.63..1..1.1..



Type code
A10V.63..1..1.6 + A10V.40..1..1..

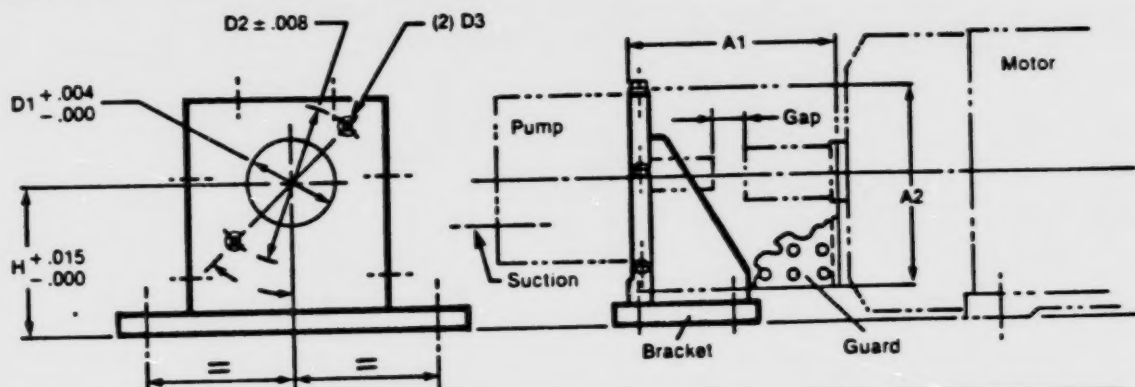


Type code
A10V.63..1..1.6 + A10V.25..1..1.1..



Type code
A10V.63..1..1.6 + S20S

PUMP BRACKET AND GUARDS FOR A10V



Pump A10V	Motor Frame	Bracket Part No.	Design No. Pg. 1	H	D1	D2	D3	Guard Part No.	A1	A2	Gap
25 or 40			2	5.25	4.004	5.750	1/2-13NC	P810 935	6.25	7.62	.85
	213T-215T	P810 938		6.25				P810 486	7.50		1.10
	254T-256T	P810 939		7.00				P810 487	8.12		1.25
	284T-286T	P810 940	3	8.00				P810 936	8.75		
	324T-326T	P810 941									
63			3	7.00	5.004	7.125	5/8-11NC	P810 487	8.12	10.38	1.25
	284T-286T	P810 942		8.00				P810 936	8.75		
	324T-326T	P810 943	4	9.00				P810 937	7.50	12.44	1.44
	364TS-365TS	P810 944						P810 492	9.38		
	364T-365T										

REXROTH

WORLDWIDE HYDRAULICS

MOBILE HYDRAULICS DIVISION

P.O. Box 394
1700 Old Mansfield Road • Wooster, Ohio 44691
Telephone: 216-262-2010 TELEX: 98-6335

INDUSTRIAL HYDRAULICS DIVISION

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2315 City Line Road • Bethlehem, PA 18018
Telephone: 215-694-8300 TELEX: 84-7498

Specifications, descriptions and illustrative material shown herein were as accurate as known at the time this publication was approved for printing. Rexroth reserves the right to discontinue models or options at any time or to change specifications, materials, or designs without notice and without incurring obligations. Optional equipment and accessories may add cost to the basic unit, and some options are available only in combination with certain models or other options. For the available combinations refer to the relevant data sheets for the basic unit and the desired option. Information contained herein should be confirmed before placing orders.

**MANNESMANN
REXROTH**
**Direct Operating Pressure Relief Valve
Type DBD / Series 10**
**RE
25 402/9.84**

 Replaces: 3.83
and RE 25 403

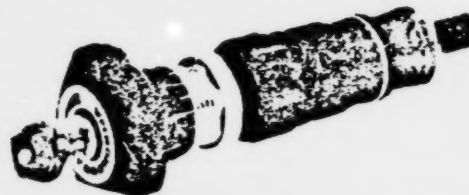
Sizes 6 to 30

up to 630 bar

up to 330 L/min

- as cartridge valve
- for threaded connections
- for subplate mounting
- 3 optional pressure setting elements:
setting screw with protective cap
handknob/handwheel
lockable handknob

K 3433/1



Typ DBDA..K10/..

Description of Function, Section

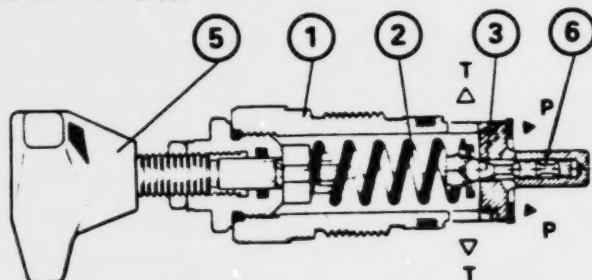
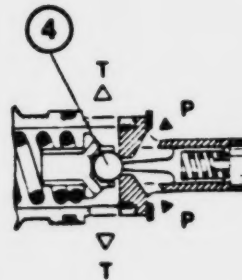
Pressure relief valves type DBD are direct operated poppet valves.

They serve to limit pressure in a system.

The valves consist basically of a sleeve (1), spring (2), poppet with damping spool (3) (up to 400 bar) or ball (4) (630 bar) and the pressure setting element (5), by means of which system pressure is steplessly set. Spring (2) presses poppet (3) on to its seat. The P-line is connected to the system. Pressure in the system acts on the face of the poppet (or ball).

If pressure in the P-line increases beyond the value set at spring (2), poppet (3) opens against spring (2). Oil now flows from the P-line into the T-line. The stroke of the poppet is limited by a pin.

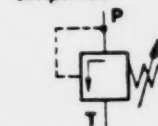
In order to obtain accurate pressure setting over the complete pressure range, the pressure range has been divided into 7 pressure ratings, each corresponding to a specific spring with a relevant maximum pressure setting.


 Type DBDH..K10/...
Model for up to 400 bar (poppet valve)


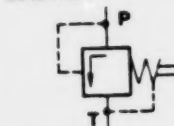
630 bar model (ball valve)

Symbols

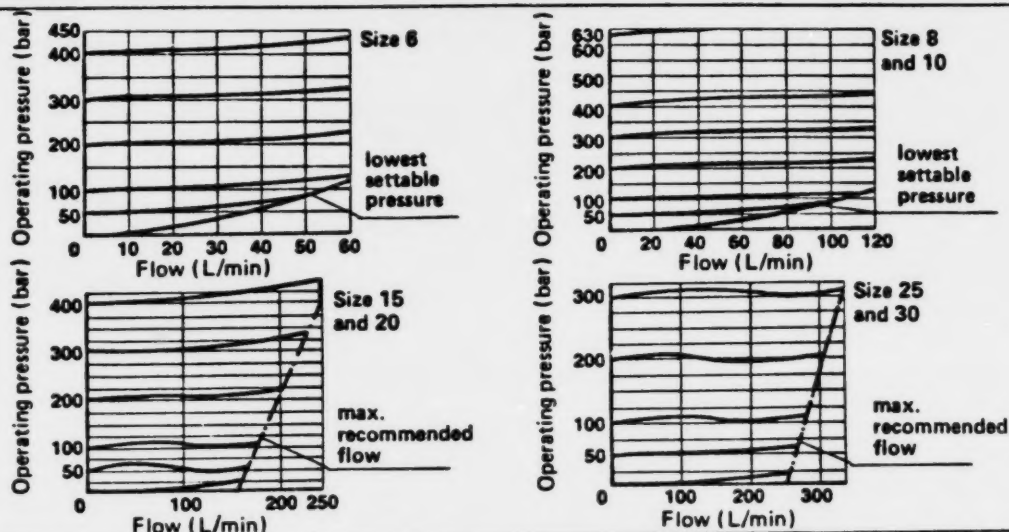
simplified



detailed


Ordering Code

DBD					10		.	Further details in clear text	
Setting screw with protective cap		= S					Suitable for:		
Handknob (up to size 20)		= H					mineral oil to		
handwheel (sizes 25 and 30)							DIN 51524 and 51525 (H-L, H-LP)		
Lockable handknob (up to size 10)		= A					V = phosphate-ester (HF-D)		
Type of connection		G	K	P	Size 10		Size 6 to 20	Size 25 and 30	
Size 6 (1/4" BSP)		= 6	6	6	Ordering Code				
Size 8 (3/8" BSP)		= 8	-	-	25 = 25 bar		25 = 25 bar	25 = 25 bar	
Size 10 (1/2" BSP)		= 10	10	10	50 = 50 bar		50 = 50 bar	50 = 50 bar	
Size 15 (3/4" BSP)		= 15	-	-	100 = 100 bar		100 = 100 bar	100 = 100 bar	
Size 20 (1" BSP)		= 20	20	20	200 = 200 bar		200 = 200 bar	200 = 200 bar	
Size 25 (1 1/4" BSP)		= 25	-	-	315 = 315 bar		315 = 315 bar	315 = 315 bar	
Size 30 (1 1/2" BSP)		= 30	30	30	400 = 400 bar		400 = 400 bar	-	
					630 = 630 bar		-	-	
Cartridge valve				= K	10 =		Series 10 (10 to 19 &		
Threaded connections				= G	install. and connection dimens. remain unchanged)				
Subplate mounting				= P					

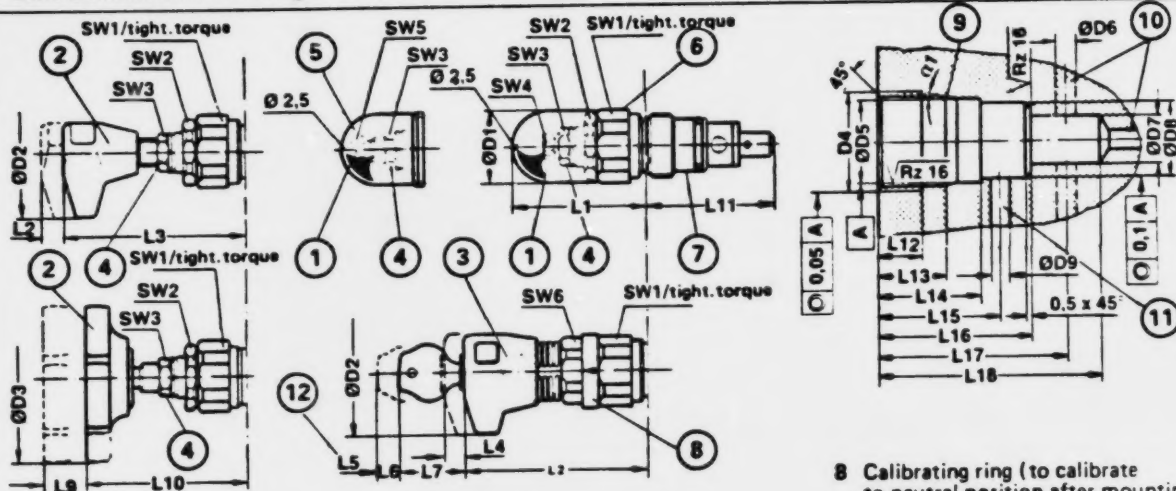
Operating Curves (measured at $\nu = 36 \text{ mm}^2/\text{s}$ and $t = 50^\circ\text{C}$)

Technical Data (For applications outside these parameters, please consult us)

Hydraulic fluid:
Mineral oil to DIN 51524 and 51525 (H-L, H-LP);
Phosphate-ester (HF-D)
Fluid temperature range: -20 to $+70^\circ\text{C}$
Viscosity range: 2.8 to $380 \text{ mm}^2/\text{s}$

Operating pressure range	Size 10	Sizes 6 to 20	Sizes 25 and 30
— inlet side (bar)	up to 630	up to 400	up to 315
— outlet side (bar)	up to 315		

Unit Dimensions: Cartridge Valve (Dimensions in mm)



1 Adjustment type "S"
Setting screw for pressure setting;
internal hexagon (up to size 20)
external hexagon (size 30)

2 Adjustment type "H"
handknob for press. setting (up to size 20)
handwheel for pressure setting (size 30)

3 Adjustment type "A"
handknob with lock for pressure
setting (up to size 10)

4 Locknut
5 Protective cap

6 Type code
7 Pressure rating (stamped on)

8 Calibrating ring (to calibrate
to neutral position after mounting
valve; fix ring by pushing until it
locks on to plug (6 A/F))

9 Mounting hole

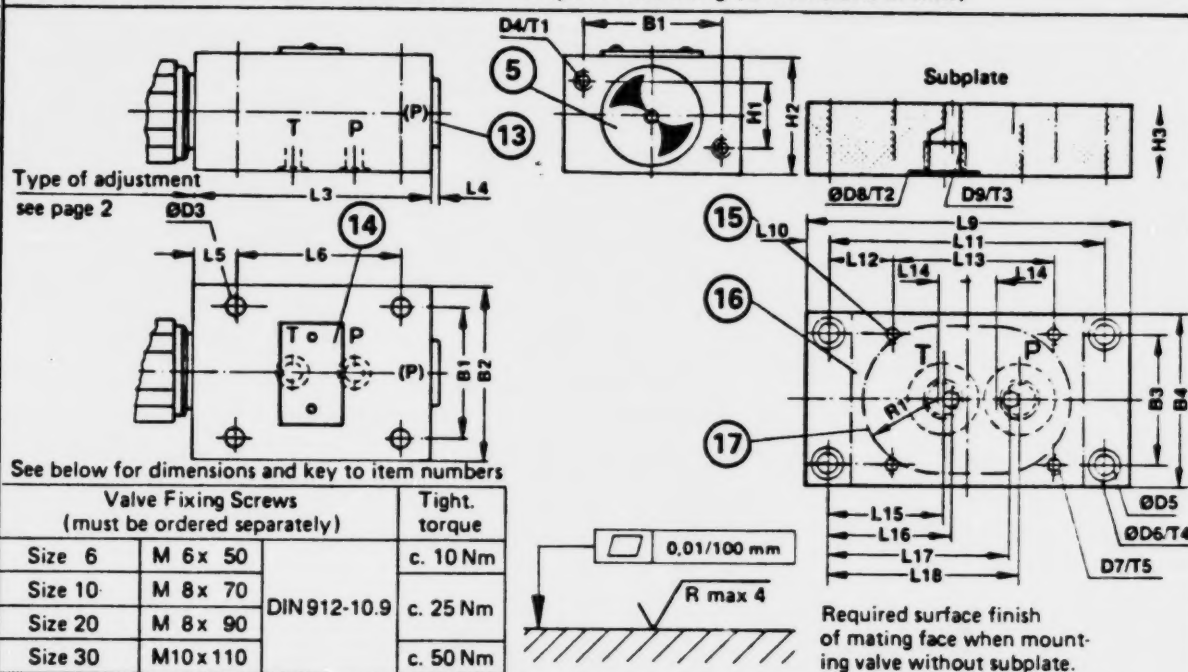
10 P port, optional positioning
on perimeter or front face

11 T port

12 Space required for removal of key

Unit	Weight	D1	D2	D3	L1	L2	L3	L4	L5	L6	L7	L8	L9	L10	L11	SW1	tight. torque	SW2*	SW3*	SW4*	SW5*	SW6*		
Size 6	c. 0.4 kg	34	60	—	72	11	83	20	11	30	79	—	—	64,5	32	c. 120 Nm	30	19	* spanner size	6	—	30		
Size 10	c. 0.5 kg	38			68		79								77	36							c. 140 Nm	
Size 20	c. 1 kg	48			65		77								106	46							c. 170 Nm	36
Size 30	c. 2.2 kg	63			—		80								83	—							—	—
Mounting Hole		D4	D5	D6	D7	D8	D9	L12	L13	L14	L15	L16	L17	L18	α1									
Size 6	M 28 x 1,5	25 ^{H9}	6	15	24,9	6	15	19	30	35	45	56,5 ± 0,5	65	15°										
Size 10	M 35 x 1,5	32 ^{H9}	10	18,5	31,9	10	18	23	35	41	52	67,5 ± 0,5	80	20°										
Size 20	M 45 x 1,5	40 ^{H9}	20	24	39,9	20	21	27	45	54	70	91,5 ± 0,5	110											
Size 30	M 60 x 2	55 ^{H9}	30	38,75	54,9	30	23	29		60	84	113,5 ± 11,5	140											

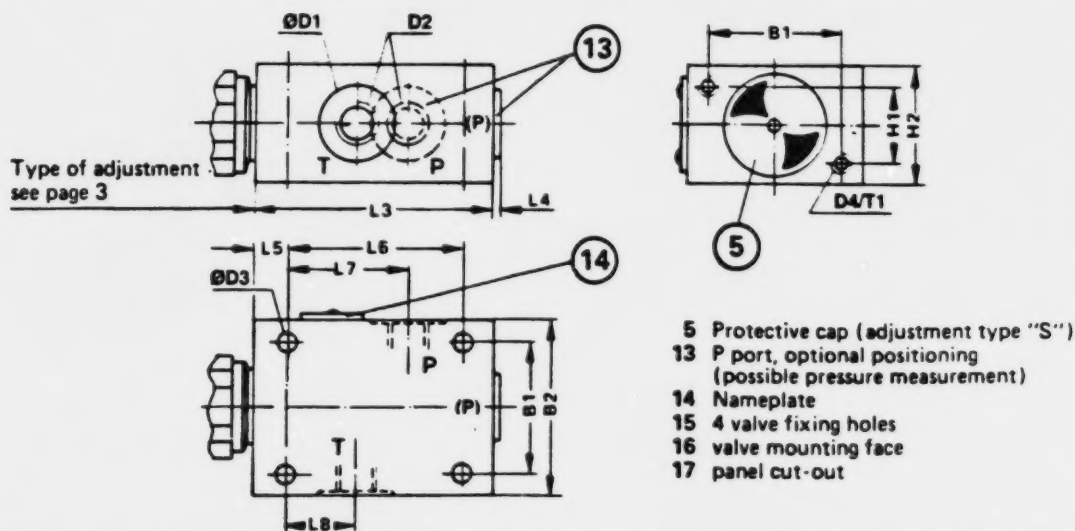
Unit Dimensions: Pressure Relief Valve for Subplate Mounting (Dimensions in mm)



Subplate	Type	Weight	B3	B4	D5	D6	D7	ØD8	D9	H3
Size 6	G 300/01	1,5 kg	45	60	7	11	M 6	25	1/4" BSP	25
Size 10	(G 301/01) G 302/01	2 kg	60	80			M 8	(28) 34	(3/8") 1/2" BSP	
Size 20	(G 303/01) G 304/01	5,5 kg	70	100	11,5	17,5	M10	(42) 47	(3/4") 1" BSP	40
Size 30	(G 305/01) G 306/01	8 kg	100	130				(56) 61	(1 1/4") 1 1/2" BSP	

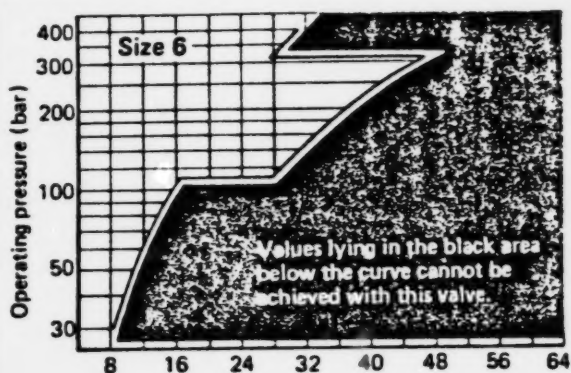
Subplate	L9	L10	L11	L12	L13	L14	L15	L16	L17	L18	T2	T3	T4	T5	R1
Size 6	110	8	94	22	55	10	39	42	62	65	1	15	9	15	25 ⁻²
Size 10	135	10	115	27,5	70	12,5	40,5	48,5	72,5	80,5		(15) 16	9		30 ⁻⁵
Size 20	170	15	140	20	100	20	(45) 42	54	85	(94) 97		20	13	(12) 22	40 ⁻³
Size 30	190	12,5	165	17,5	130	22,5	42	52,5	102,5	(113) 117		24	11,5	22	55 ⁻⁴

Unit Dimensions: Pressure Relief Valve for Threaded Connections (Dimensions in mm)



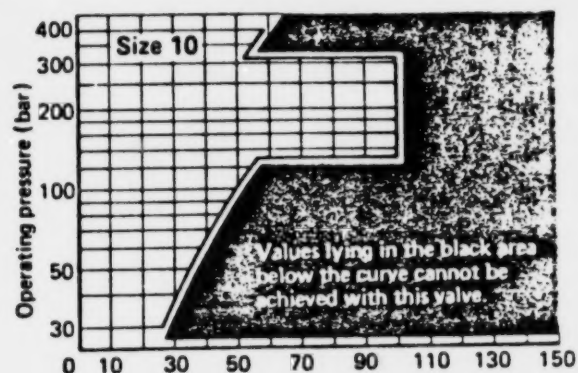
Unit	B1	B2	ØD1	D2	ØD3	D4	H1	H2	L3	L4	L5	L6	L7	L8	T1	Weight
Size 6	45	60	25	1/4" BSP	6,6	M 6	25	40	80	4	15	55	40	20	10	c. 1.5 kg
Size (8) + 10	60	80	(28) 34	(3/8") 1/2" BSP	9	M 8	40	60	100	4	20	70	49	21	20	c. 3.7 kg
Size (15) + 20	70	100	(42) 47	(3/4") 1" BSP			50	70	135	(4) 5,5		100	65	34		c. 6.4 kg
Size (25) + 30	100	130	(56) 61 (1 1/4")	1 1/2" BSP	11	M10	60	90	180	5,5	25	130	85	35	25	c. 13.9 kg

Design Tested Pressure Relief Valves Type DBD.../..B

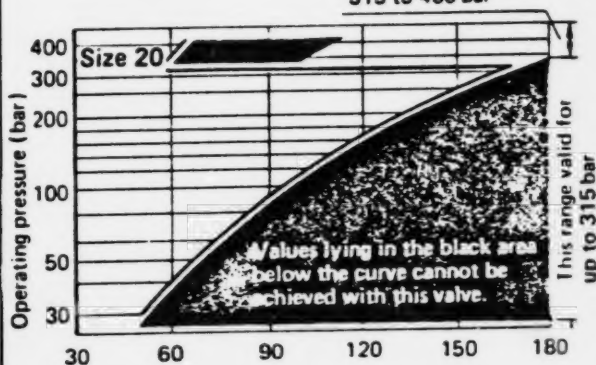


Flow Q in L/min in relation to α_w -value; α_w for 30 to 110 bar = 0.1
 α_w for 111 to 315 bar = 0.17
 α_w for 316 to 400 bar = 0.1

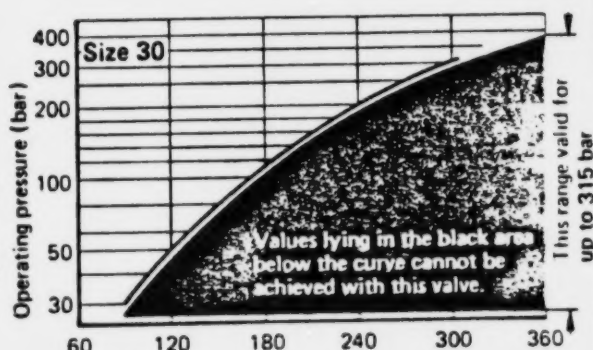
This range valid for 315 to 400 bar



Flow Q in L/min in relation to α_w -value; α_w for 30 to 130 bar = 0.22
 α_w for 131 to 315 bar constant 100 L/min
 α_w for 316 to 400 bar = 0.13



Flow Q in L/min in relation to α_w -value; α_w for 30 to 315 bar = 0.15
 α_w for 315 to 400 bar = 0.05



Flow Q in L/min in relation to α_w -value; α_w for 30 to 315 bar = 0.12

The ordering code for a design tested relief valve is made up of a model code and a component code

Size	Model code	Component code
6	DBDS 6K11/ ☐ B	TUV.SV.77-359.5.F. α_w .p.
	DBDH 6K11/ ☐ B	
	DBDS 6G11/ ☐ B	
	DBDH 6G11/ ☐ B	
	DBDS 6P 11/ ☐ B	
	DBDH 6P 11/ ☐ B	
10	DBDS 8G11/ ☐ B	TUV.SV.77-360.6.F. α_w .p.
	DBDH 8G11/ ☐ B	
	DBDS 10K11/ ☐ B	
	DBDS 10G11/ ☐ B	
	DBDS 10P 11/ ☐ B	
	DBDH 10K11/ ☐ B	

☐ Customer to insert required pressure rating in model code

Size	Model code	Component code
20	DBDS 15G11/ ☐ B	TUV.SV.77-361.10.F. α_w .p.
	DBDH 15G11/ ☐ B	
	DBDS 20K11/ ☐ B	
	DBDS 20G11/ ☐ B	
	DBDS 20P11/ ☐ B	
	DBDH 20K11/ ☐ B	
30	DBDS 25G11/ ☐ B	TUV.SV.77-362.15.F. α_w .p.
	DBDH 25G11/ ☐ B	
	DBDS 30K11/ ☐ B	
	DBDS 30G11/ ☐ B	
	DBDS 30P 11/ ☐ B	
	DBDH 30K11/ ☐ B	

Mannesmann Rexroth GmbH, Jahnstraße 3-5; D-8770 Lohr am Main; Tel.: 09352/180; Telex: 0689418

G.L. Rexroth Ltd. Cromwell Road St. Neots/Hunt., Cambs. PE192ES Tel. 0480/76041 Tlx. 32 161

LEVER ADJUST
FOR OIL TO 25 G.P.M. (95 L/MIN.)
TO 3000 P.S.I. (210 bar)

LEVER ADJUST - 180° PRESSURE COMPENSATED FLOW CONTROLS RESTRICTIVE OR BYPASS STYLE



USE

For use in circuits where adjustable pressure compensated speed control is required, and for operator convenience the manual adjustment of the flow control is "Lever" operated through a 180° arc. Available in either the 2-ported Restrictive Style or 3-ported Bypass Style Flow Regulator.

OPERATION

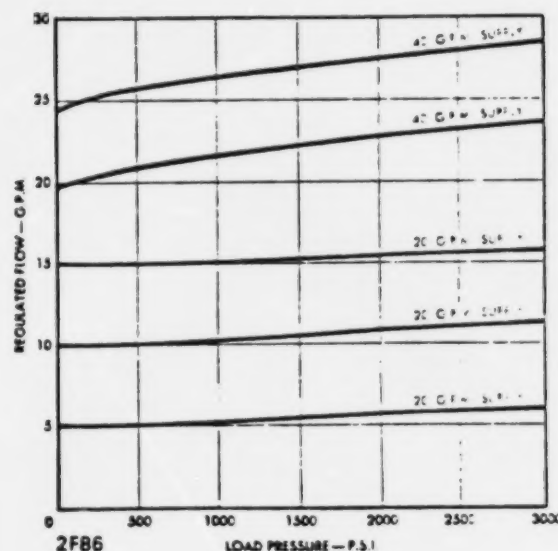
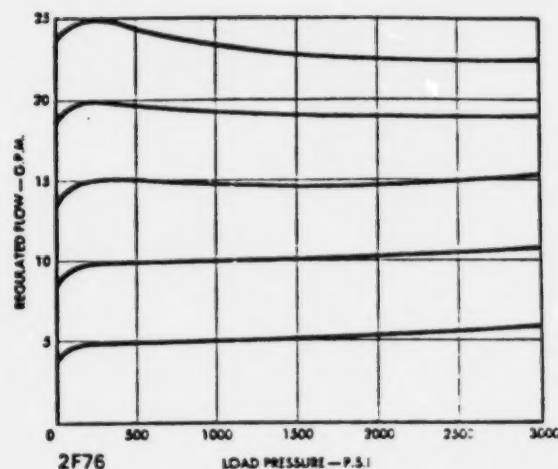
The Lever Adjustment controls the size of the variable control orifice. The orifice arrangement uses a rotating inner and fixed outer sleeve with intersecting milled slots which results in a linear adjust curve. Both valves maintain constant regulated flow even with changes in the load pressure or input (pump) flow to valve.

Restrictive Style Valve - most commonly used in meter in and meter out applications. Flow through the control orifice produces a pressure drop sensed across the regulating section. Any tendency to exceed the flow setting of the valve increases this pressure differential until it exceeds the spring force and shifts the spool to throttle or restrict flow to the regulated port maintaining constant regulated flow.

Bypass Style Valve - most commonly used with fixed displacement pumps in meter in applications. Flow through the control orifice produces a pressure drop sensed across the regulating section. Any tendency to exceed the flow setting of the valve increases this pressure differential until it exceeds the spring force and shifts the spool allowing surplus oil to be bypassed to tank, thus maintaining constant regulated flow.

FEATURES

- Rugged sturdy adjust design — built for hard duty.
- Large easy to read numbered dial
- Built-in friction clutch — maintains setting yet allows quick easy readjustment.
- Customer selected maximum regulated flow — gives full adjust sensitivity over the 180° arc



SPECIFICATIONS

MATERIALS: Body, hi-strength wrought aluminum alloy
Internal Parts, hardened steel

RATED FLOW:

- Restrictive Style - 2F76
Regulated - to 25 GPM (95 L/min)
- Bypass Style - 2F86
Input - to 40 GPM (151 L/min)
Regulated - to 25 GPM (95 L/min)

WORKING PRESSURE: to 3000 PSI (210 bar)

FLOW REGULATORS

LEVER ADJUST
FOR OIL TO 25 G.P.M. (95 L/MIN.)
TO 3000 P.S.I. (210 bar)

**fluid
controls, Inc.**

PART NUMBER EXAMPLE:

HOW TO ORDER

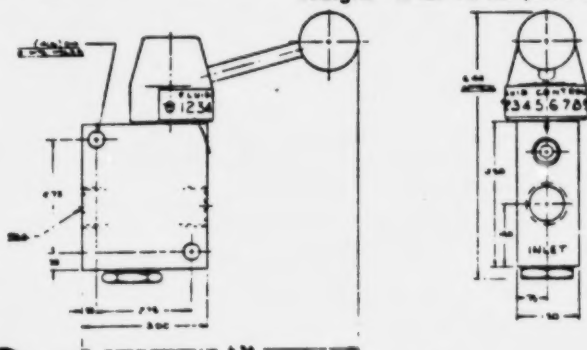
2F76 - L 6-6 - 25 S

① ② ③ ④ ⑤

Where measurements are critical -
request certified drawings.

① 2F76 RESTRICTIVE

Weight - 2 lb. 10 oz. (1.19 Kg)



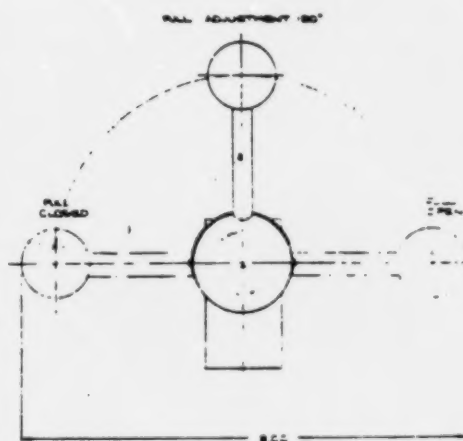
③ PORT SIZE

	Inlet	Regulated
4* - 4*	1/2" NPTF	1/2" NPTF
6* - 6*	3/4" NPTF	3/4" NPTF
8T - 8T	1/2" SAE	1/2" SAE
12T - 12T	3/4" SAE	3/4" SAE

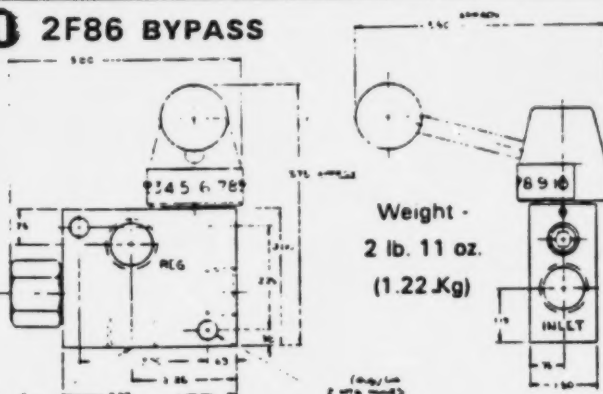
*Add W after each number for equivalent port with BSPPL thread.

② ADJUST MEANS

L Lever Adjustment (180°)



① 2F86 BYPASS



Weight -
2 lb. 11 oz.
(1.22 Kg)

③ PORT SIZE

	Inlet	Tank	Reg.
4* - 4* - 4*	1/2" NPTF	1/2" NPTF	1/2" NPTF
6* - 6* - 6*	3/4" NPTF	3/4" NPTF	3/4" NPTF
8T - 8T - 8T	1/2" SAE	1/2" SAE	1/2" SAE
12T - 12T - 12T	3/4" SAE	3/4" SAE	3/4" SAE

*Add W after each number for equivalent port with BSPPL thread

④ ADJUSTABLE FLOW RANGE

25 0 - 25 GPM Standard (0 - 95 L/min)
— Specify desired maximum flow range
(0 - 6 GPM minimum flow range)
(0 - 2.3 L/min)

⑤ SEALS

S Buna N (For use with most industrial oils)
SV Viton A

Consult
factory
for
details
and
availability

REKROTH
WORLDWIDE HYDRAULICS
Bethlehem, Pa. 18018
215/694-8300

Check Valve Type S

Sizes 6 (1/4") to 30 (1 1/2")

up to 4500 PSI

RA
20377

Description

for in-line mounting or as cartridge unit

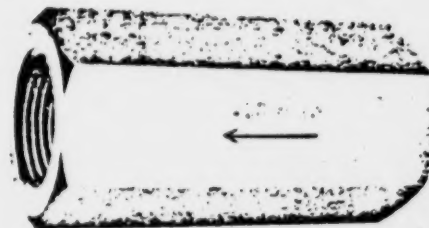
Issue 1.75—U.S.A.

The check valves type S serve to give leakfree closure in one direction and free return flow in the other

The stroke of the valve poppet is limited by a stop. The built-in spring supports the closing stroke, and also serves to hold the valve poppet in the closed position.

Four versions are available, with cracking pressures of 7, 22 or 45 PSI or without a spring

A check valve cartridge is also available, suitable for mounting in manifold blocks. Two models are available: straight or angled valve cartridge



Ordering Code

Model Number

S A . / 5 *

Check valve = S

Unit

Size 6 (1/4") = 6
Size 8 (3/8") = 8
Size 10 (1/2") = 10
Size 15 (3/4") = 15
Size 20 (1") = 20
Size 25 (1 1/4") = 25
Size 30 (1 1/2") = 30

Size

Add further details in clear text

In-line mounting = A

Connections

Type No. 0 (without spring) = 0
Type No. 1 (cracking pressure 7 PSI) (Standard) = 1
Type No. 2 (cracking pressure 22 PSI) = 2
Type No. 3 (cracking pressure 45 PSI) = 3

Design no.

none (specified by factory) = 0

Modification no.

Part numbers for check valve cartridge

Straight valve

Type	No. 1	No. 2	No. 3
Size 6 (1/4")	301 889	301 896	301 903
Size 8 (3/8")	301 890	301 897	301 904
Size 10 (1/2")	301 891	301 898	301 905
Size 15 (3/4")	301 892	301 899	301 906
Size 20 (1")	301 893	301 900	301 907
Size 25 (1 1/4")	301 894	301 901	301 908
Size 30 (1 1/2")	301 895	301 902	301 909

Angled Valve

Type	No. 1	No. 2	No. 3
Size 6 (1/4")	301 910	301 917	301 924
Size 8 (3/8")	301 911	301 918	301 925
Size 10 (1/2")	301 912	301 919	301 926
Size 15 (3/4")	301 913	301 920	301 927
Size 20 (1")	301 914	301 921	301 928
Size 25 (1 1/4")	301 915	301 922	301 929
Size 30 (1 1/2")	301 916	301 923	301 930

Technical Data (Valve description: RA 20 000)

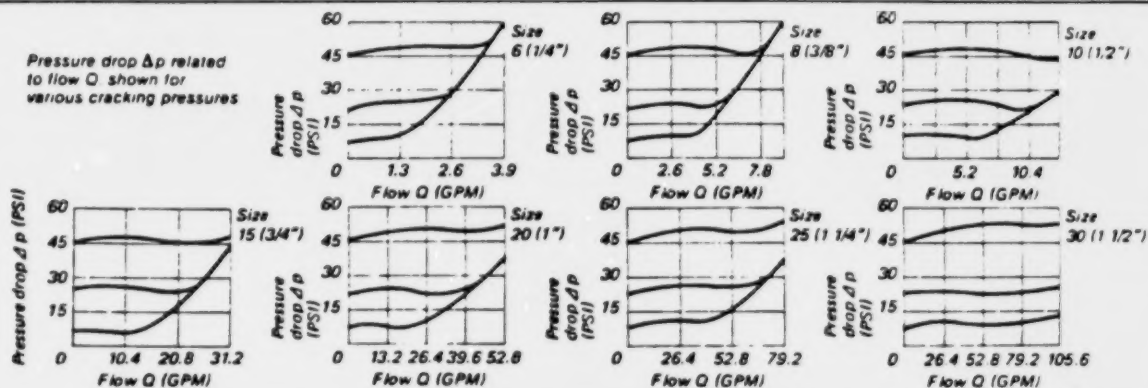
Spares information: RE 20 377-E

Hydraulic medium	Mineral oils
Fluid temperature range	-22°F to +176°F
Viscosity range	35 to 1750 SSU
Max. operating pressure	4500 PSI

Cracking pressure (PSI)	7 (Type No. 1), 22 (No. 2), 45 (No. 3)
Size	6 (1/4") 8 (3/8") 10 (1/2") 15 (3/4") 20 (1") 25 (1 1/4") 30 (1 1/2")
Flow Rating (GPM)	2.6 4.8 7.9 17.2 30.4 46.3 68.8
Velocity = 20 ft/s	

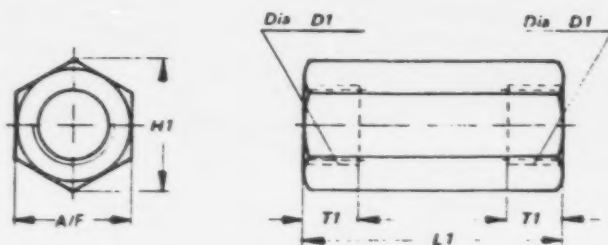
Performance Curves

Pressure drop Δp related to flow Q shown for various cracking pressures

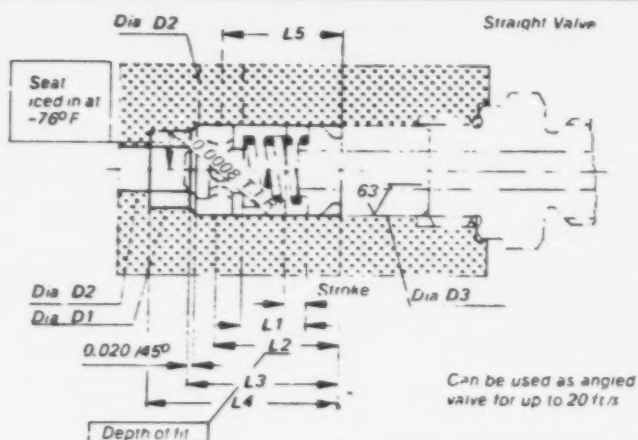


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WORLDWIDE HYDRAULICS

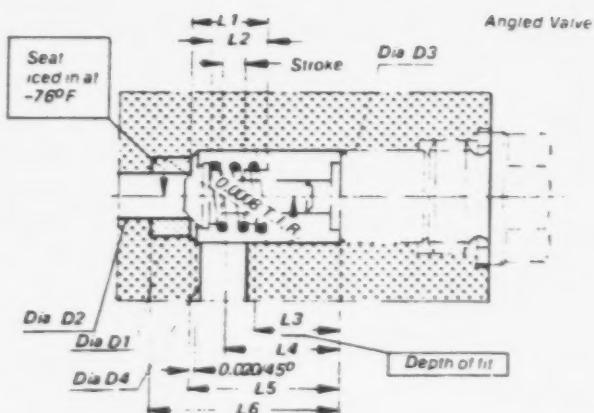
Unit Dimensions (in inches)



Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	1/4" NPT	3/8" NPT	1/2" NPT	3/4" NPT	1" NPT	1 1/4" NPT	1 1/2" NPT
H1	0.866	1.102	1.358	1.634	2.087	2.717	2.953
L1	2.283	2.283	2.835	3.346	3.858	4.724	5.197
T1	0.472	0.472	0.551	0.630	0.709	0.787	0.866
A/F	0.748	0.945	1.181	1.417	1.811	2.362	2.559
Weight Lbs	0.22	0.44	0.66	1.1	2.2	4.4	5.5

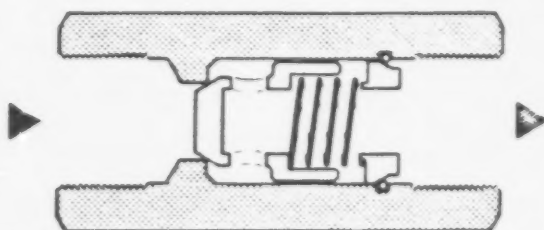


Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	0.39429 0.39370	0.51251 0.51181	0.67000 0.66929	0.86636 0.86514	1.10318 1.10276	1.41630 1.41732	1.65452 1.65364
D2	0.236	0.315	0.394	0.591	0.787	0.984	1.181
D3	0.43413 0.43307	0.55224 0.55118	0.70972 0.70866	0.94618 0.94498	1.18240 1.18110	1.49759 1.49605	1.73381 1.73228
Stroke	0.157	0.157	0.157	0.197	0.197	0.276	0.276
L1	0.374	0.374	0.453	0.571	0.630	0.965	0.984
L2	0.748	0.709	0.827	1.063	1.142	1.535	1.654
L3	0.858	0.898	1.134	1.433	1.732	2.165	2.480
L4	1.173	1.291	1.528	1.906	2.323	2.874	3.265
L5	0.709	0.709	0.906	1.102	1.299	1.614	1.850
Weight Lbs	0.11	0.11	0.11	0.22	0.44	0.55	0.66



Size	6 (1/4")	8 (3/8")	10 (1/2")	15 (3/4")	20 (1")	25 (1 1/4")	30 (1 1/2")
D1	0.39429 0.39370	0.51251 0.51181	0.67000 0.66929	0.86636 0.86514	1.10318 1.10236	1.41630 1.41732	1.65452 1.65364
D2	0.236	0.315	0.394	0.591	0.787	0.987	1.181
D3	0.43413 0.43307	0.55224 0.55118	0.70972 0.70866	0.94618 0.94498	1.18240 1.18110	1.49759 1.49605	1.73381 1.73228
D4	0.236	0.315	0.394	0.591	0.787	0.984	1.181
Stroke	0.157	0.157	0.157	0.197	0.197	0.276	0.276
L1	0.441	0.464	0.563	0.709	0.740	1.122	1.122
L2	0.374	0.374	0.453	0.571	0.630	0.965	0.984
L3	0.394	0.630	0.630	0.709	0.906	1.220	1.457
L4	0.650	0.846	0.925	1.004	1.181	1.693	1.870
L5	0.807	1.043	1.161	1.339	1.594	2.264	2.500
L6	1.122	1.437	1.555	1.811	2.185	2.972	3.287
Weight Lbs	0.11	0.11	0.11	0.22	0.44	0.55	0.66

Section



Symbol



THE REXROTH CORPORATION/BETHLEHEM, PA. 18018

2315 City Line Road L V I P

Phone: 215/694-8300

Telex: 84 7414

REXROTH

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Printed in U.S.A.
RA 20 377/1 75-11 Replaces RA 22 001

REXROTH
WORLDWIDE HYDRAULICS
BETHLEHEM, PA 18018

COMBINATION THROTTLE & CHECK VALVE type DRV & DRVP

RA
RA 32552

ENGINEERING DATA SHEET

1/4 to 2" Threaded and Manifold Mounting

Issued: 8-1-79
Revised: 8-1-80

NPT or SAE Threaded

5000 PSI (350 bar)

100 GPM (400 l/min)

GENERAL DESCRIPTION...This is an in-line or manifold mounted adjustable flow control valve with a return check valve. It has a bar stock body which is available with NPT or SAE thread in addition to the manifold mounted model.

The valve incorporates a slotted needle to provide accurate control of flow. By turning the control knob counterclockwise, the flow increases uniformly. Free flow in the reverse direction is through the check valve passage of the valve body.

A color coded rising stem is provided to indicate the position of the valve opening. This visible indicator permits repeatable valve settings.

A set screw is provided in the hand knob to lock the setting.

OPERATING PRESSURE...5000 PSI (350 bar)

FLOW RATING...See Valve Performance Charts

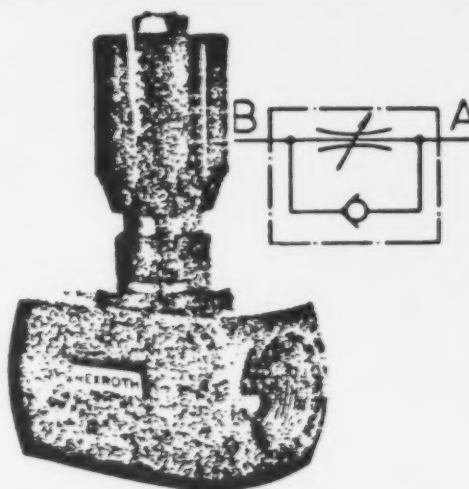
OPERATING TEMPERATURE...-20°F (-29°C) to +212°F (+100°C)

FLUID RECOMMENDATIONS...These valves are supplied, as a standard, with Viton seals. Viton seals are compatible with most hydraulic fluids.

VISCOSITY RANGE...35 SSU (2.8cSt) to 1750 SSU (380cSt)

MOUNTING POSITION...Optional

WEIGHT...See Installation Dimensions Charts



ORDERING CODE

Model Number Example

DRV - 8 - 1.X/5 - V-S

MODEL NUMBER



S = Panel Mtg. Kit*
Omit = If not needed

V = SEALS
Viton

5 = PIPE CONNECTION
12 = NPT
SAE

X = SERIES NO.

Numbered 0 to 9

This number is assigned by the factory and is used for ordering spare parts.

1 = DESIGN NO.
Steel

*Available with In-line models only

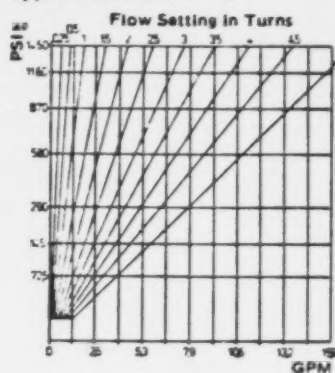
IN-LINE
MANIFOLD = DRV
= DRVP

VALVE SIZE

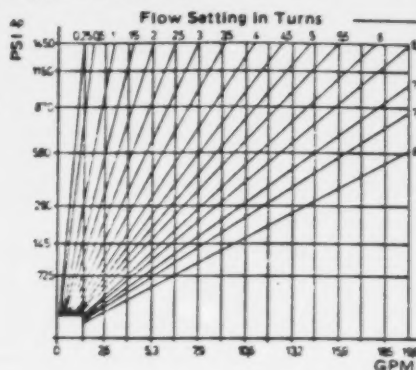
SAE UNF-2B	NPT	ORDER CODE
7/16-20	1/4	= 8
9/16-18	3/8	= 10
3/4-16	1/2	= 12
1-1/16-12	3/4	= 16
1-5/16-12	1"	= 20
1-5/8-12	1-1/4	= 25
1-7/8-12	1-1/2	= 30
2-1/2-12	2"	= 40

Test Performed with Hydraulic Oil 122°F (50°C) and 165 SSU (35cSt)

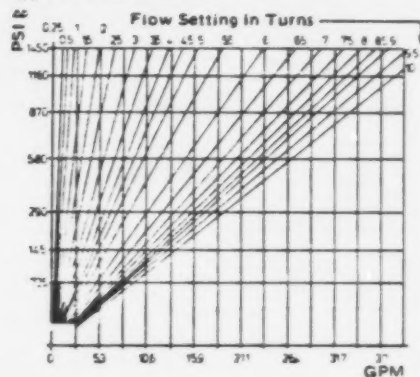
Types: DRV/DRVP - 8



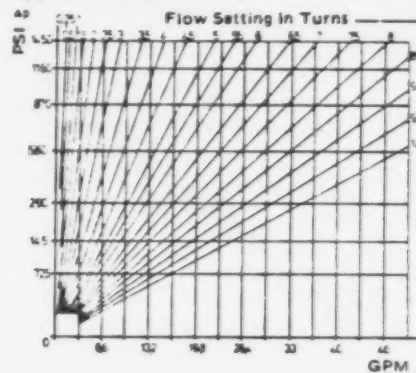
Types: DRV/DRVP - 10



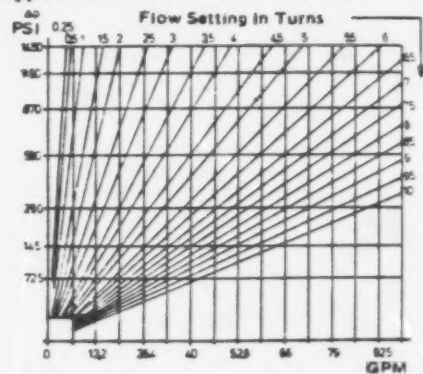
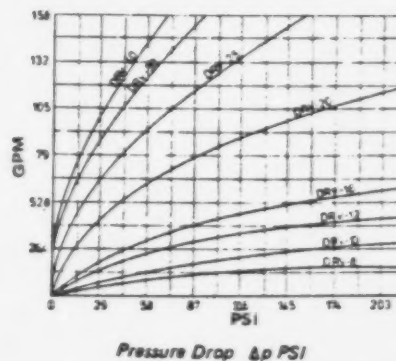
Types: DRV/DRVP - 12



Types: DRV/DRVP - 16



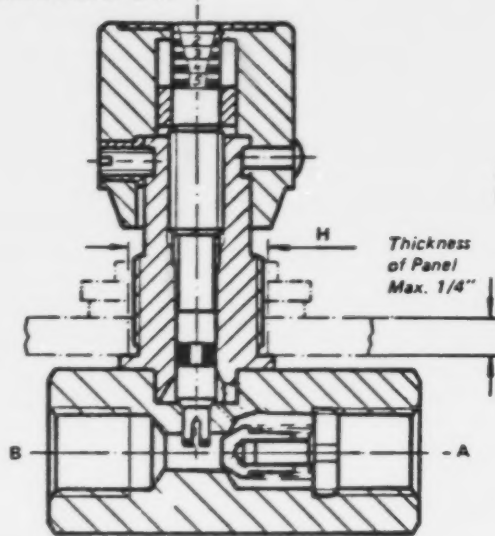
Types: DRV/DRVP - 20/25/30/40

Flow direction: B → A
Δp curves free flow

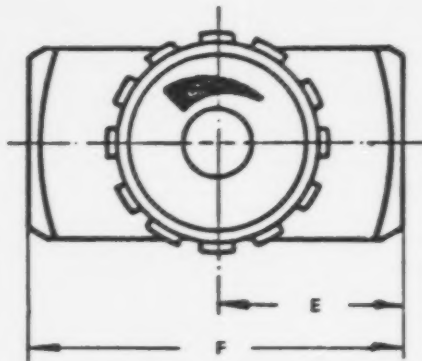
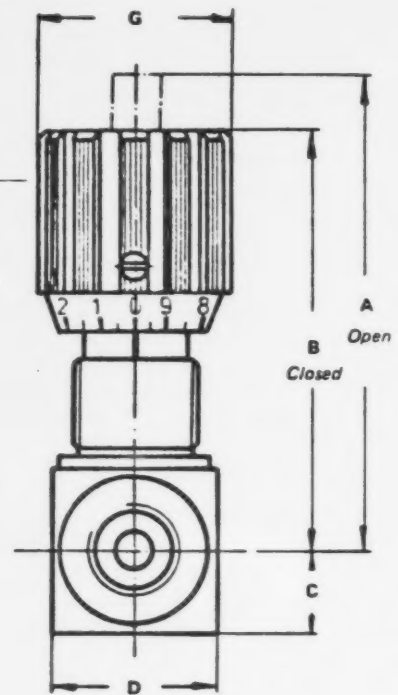
DIMENSIONS: Inches (mm)

RA 32552

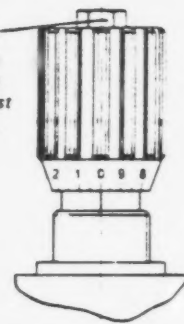
INSTALLATION DIMENSIONS: DRV



For Sizes
8 - 16



Valve sizes 20
thru 40 have a
hex head for a
wrench to assist
in adjustment.



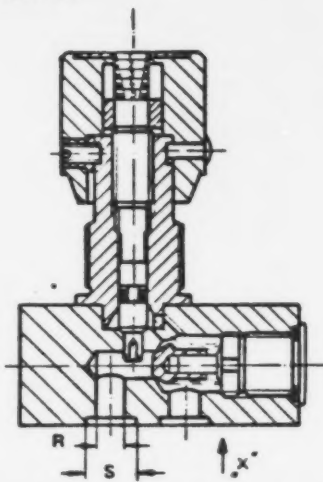
INSTALLATION DIMENSIONS inches and (mm) - weight, lbs. (kg.)

VALVE SIZE	A	B	C	D Sq.	E	F	G Dia.	H Dia.	Weight
8 1/4	2.84 (72)	2.56 (65)	0.50 (13)	0.98 (25)	1.31 (29)	2.16 (55)	1.14 (29)	0.75 (19)	0.6 (0.3)
10 3/8	2.91 (74)	2.63 (67)	0.59 (15)	1.19 (30)	1.61 (41)	2.56 (65)	1.14 (29)	0.75 (19)	1.0 (0.4)
12 1/2	3.63 (86)	3.25 (83)	0.69 (18)	1.38 (35)	1.75 (44)	2.88 (73)	1.50 (38)	0.91 (23)	1.8 (0.8)
16 3/4	4.17 (106)	3.81 (97)	0.88 (22)	1.75 (44)	2.25 (57)	3.47 (88)	1.50 (38)	0.91 (23)	2.8 (1.3)
20 1"	5.69 (145)	5.03 (128)	1.00 (26)	1.97 (50)	3.03 (77)	5.00 (127)	1.94 (50)	1.50 (38)	5.3 (2.4)
25 1-1/4	5.91 (150)	5.25 (134)	1.19 (30)	2.38 (60)	3.66 (93)	5.63 (143)	1.94 (50)	1.50 (38)	7.8 (3.5)
30 1-1/2	6.13 (156)	5.44 (138)	1.38 (35)	2.75 (70)	4.25 (108)	5.63 (143)	1.94 (50)	1.50 (38)	10 (4.5)
40 2"	6.50 (165)	5.81 (148)	1.75 (44)	3.53 (90)	5.13 (131)	6.50 (165)	1.94 (50)	1.50 (38)	17 (7.8)

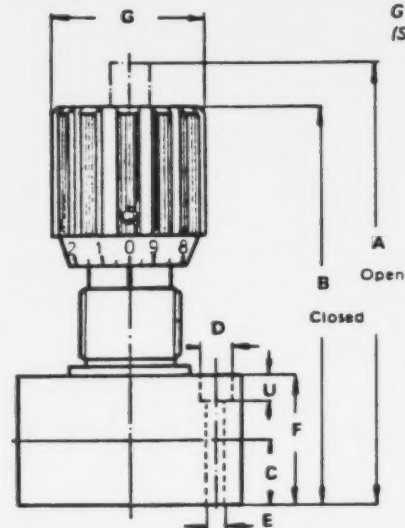
DIMENSIONS: Inches (mm)

RA 32552

INSTALLATION DIMENSIONS: DRVP
ANSI STANDARDS



For Sizes
8 - 16

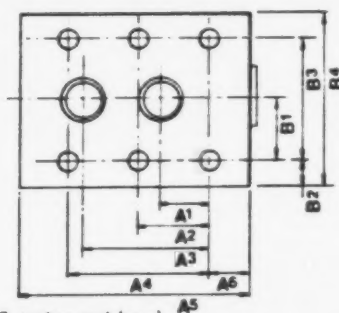


G Dimension
(See Page 3)

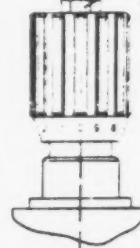
INSTALLATION DIMENSIONS inches and (mm) - weight, lbs. (kg.)

VALVE SIZE	A	B	C	D Dia.	E Dia.	F	R	S Dia.	U	WEIGHT
8 1/4	3.13 (80)	2.84 (72)	0.39 (10)	0.43 (11)	0.27 (7)	0.99 (25)	0.28 (7)	0.50 (13)	0.28 (7)	1.1 (0.5)
10 3/8	3.34 (85)	3.03 (84)	0.50 (13)	0.43 (11)	0.27 (7)	0.98 (25)	0.39 (10)	0.62 (16)	0.28 (7)	1.8 (0.8)
12 1/2	4.19 (106)	3.78 (96)	0.63 (16)	0.43 (11)	0.27 (7)	1.25 (32)	0.51 (13)	0.73 (19)	0.28 (7)	2.7 (1.2)
16 3/4	5.03 (128)	4.66 (118)	0.88 (22)	0.55 (14)	0.35 (9)	1.78 (45)	0.67 (17)	0.96 (24)	0.36 (9)	5.8 (2.6)
20 1"	6.69 (170)	6.03 (153)	0.98 (25)	0.55 (14)	0.35 (9)	1.97 (50)	0.87 (22)	1.20 (28)	0.36 (9)	8.6 (3.9)
25 1-1/4	6.88 (175)	5.91 (150)	1.69 (43)	0.71 (18)	0.43 (11)	2.16 (56)	1.12 (29)	1.48 (38)	0.44 (11)	13 (5.9)
30 1-1/2	7.68 (195)	6.69 (170)	1.47 (37)	0.79 (20)	0.55 (14)	2.97 (75)	1.38 (35)	1.91 (49)	0.50 (13)	20 (9.1)
40 2"	8.66 (220)	8.00 (204)	1.97 (50)	0.79 (20)	0.55 (14)	3.94 (100)	1.81 (46)	2.26 (57)	0.50 (13)	26 (12)

VIEW "X"



Valve sizes 20 thru 40 have
a 3/4" hex head for a wrench
to assist in adjustment.



MANIFOLD DIMENSIONS inches and (mm)

VALVE SIZE	A1	A2	A3	A4	A5	A6	B1	B2	B3	B4
8 1/4	0.198 (5)	—	1.19 (31)	1.38 (35)	2.50 (64)	0.56 (14)	0.67 (17)	0.24 (6)	1.34 (34)	1.81 (46)
10 3/8	0.16 (4)	—	1.16 (30)	1.32 (34)	2.75 (70)	0.73 (19)	0.75 (19)	0.25 (6)	1.50 (38)	2.00 (51)
12 1/2	0.16 (4)	—	1.34 (34)	1.50 (38)	3.16 (84)	0.83 (21)	0.88 (22)	0.26 (7)	1.75 (44)	2.27 (58)
16 3/4	0.43 (11)	1.50 (38)	2.55 (65)	3.00 (76)	4.10 (104)	0.55 (14)	1.06 (27)	0.31 (8)	2.13 (54)	2.75 (70)
20 1"	0.75 (19)	1.87 (48)	3.00 (76)	3.75 (95)	5.00 (127)	0.63 (16)	1.18 (30)	0.31 (8)	2.38 (60)	3.00 (76)
25 1-1/4	0.80 (21)	2.36 (60)	3.91 (101)	4.73 (120)	6.50 (165)	1.182 (30)	1.50 (38)	0.47 (12)	3.00 (76)	3.94 (100)
30 1-1/2	0.95 (24)	2.82 (72)	4.69 (119)	5.63 (143)	7.31 (186)	1.094 (28)	1.81 (46)	0.45 (11)	3.62 (92)	4.53 (115)
40 2"	0.75 (19)	2.64 (67)	4.25 (108)	5.25 (133)	7.56 (192)	1.688 (43)	2.19 (56)	0.56 (14)	4.38 (111)	5.50 (140)

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RELIEF VALVES

PILOT OPERATED

SLIDING SPOOL AND POPPET STYLE

FOR OIL - TO 40 G.P.M. (151 L/MIN), 6000 P.S.I. (420 bar)

USE

The pilot operated sliding spool and poppet models combine high accuracy and excellent pressure vs. flow characteristics. Used to limit system pressure even under conditions of widely varying flow.

OPERATION

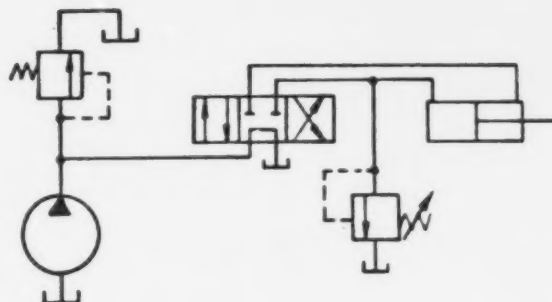
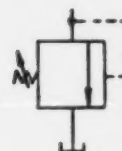
When inlet pressure exceeds the relief setting the pilot section opens. This pilot flow causes a pressure imbalance across the main section which opens and allows relief flow to tank.

FEATURES

High accuracy - of pilot operated design.

Cartridge construction - for installation in your own manifold.

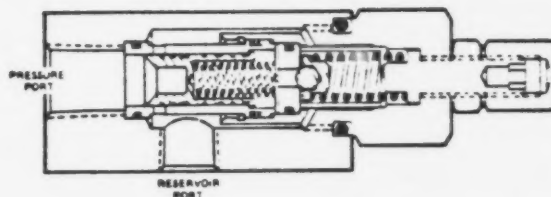
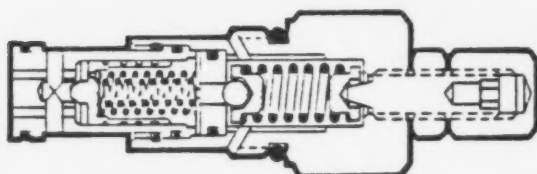
Long trouble free life - with hardened matched working parts.



1 A 20

SLIDING SPOOL TYPE
CARTRIDGE CONSTRUCTION

1 A 30

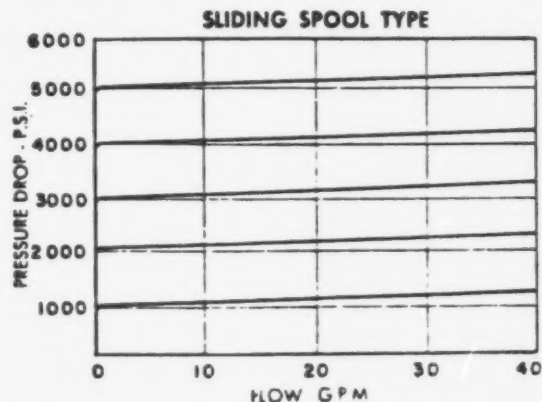
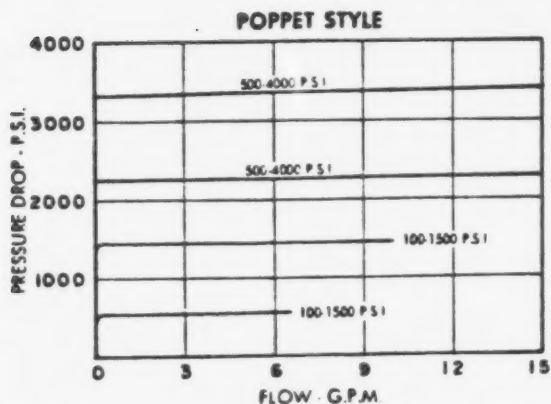


MATERIALS: Body, hi-strength wrought aluminum alloy
Internal parts, hardened steel

Cartridge housing, steel

RATED FLOW & WORKING PRESSURE: Poppet style to 15 G.P.M., (57 L/MIN) 4000 P.S.I. (280 bar)
Sliding spool to 40 G.P.M., (151 L/MIN) 6000 P.S.I. (420 bar)

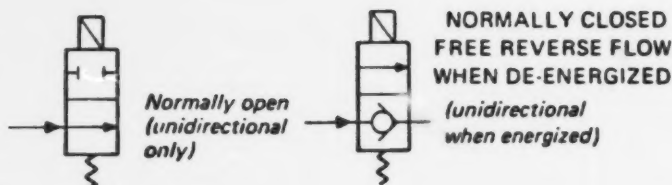
RESEAT: 1A20's 75% of set pressure
1A30's 80% of set pressure



FOR OIL - TO 40 G.P.M. (151 L/MIN), 6000 P.S.I. (420 bar)

SOLENOID CARTRIDGE

PILOT OPERATED, POPPET STYLE, TWO WAY VALVE
NORMALLY OPEN, NORMALLY CLOSED
FOR OIL - TO 5 G.P.M. (19 L/MIN), 3000 P.S.I. (210 bar)



USE

To be used as a two-way directional control in any hydraulic system with up to 5 GPM flow. Also can be used to remotely operate or pilot large pilot operated valves requiring up to 5 GPM pilot flow.

OPERATION

Normally Open.

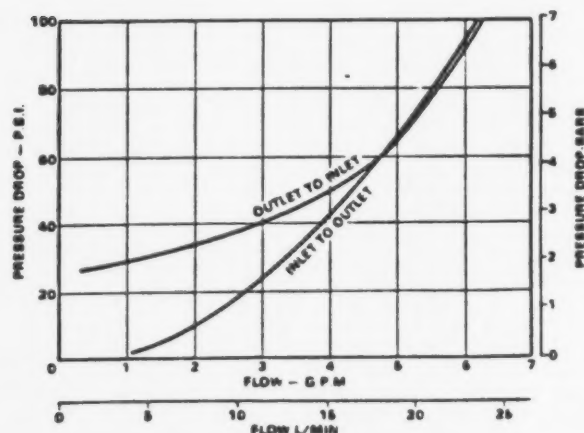
Spring tension holds the pilot poppet away from the orifice seat on the main poppet. An axial groove on the O.D. of the main poppet allows pilot flow to pass through the poppet nose. This flow pattern creates a pressure imbalance on the main poppet and causes the poppet to shift open allowing complete flow to pass through the outlet port. When the solenoid coil is energized, the armature is magnetically forced to slide the push pin and pilot poppet forward. The poppet blocks pilot flow and the main poppet shifts to a completely closed position.

Normally Closed.

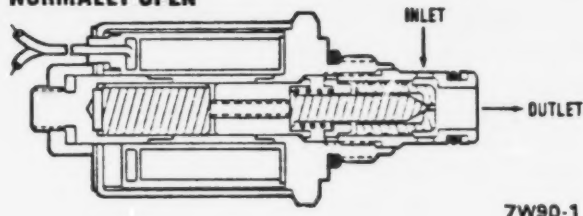
Spring tension holds the pilot poppet against the main poppet and both pilot and main flow through the valve is blocked. When the solenoid coil is energized the armature is magnetically forced to pull the pilot poppet from the orifice seat and pilot flow occurs. The pilot flow creates a pressure imbalance on the main poppet and the valve shifts open.

Optional Application.

The normally closed valve will allow reverse flow in the closed mode and is unidirectional in the energized (open) mode.

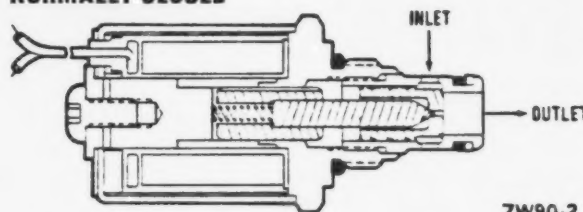


NORMALLY OPEN



7W90-1

NORMALLY CLOSED



7W90-2

FEATURES

- Reliable, excellent performance.
- Cartridge construction for use in your own cavity or complete in body.
- Hardened steel working parts.
- Replaceable weather resistant coil.

SPECIFICATIONS

WORKING PRESSURE: Rated to 3000 P.S.I. (210 bar)

VOLTAGE:

12, 24, 36 VDC, 12 Watts

115 VAC (± 10%)

50-60 hz.

12 amps

230 VAC (± 10%)

50-60 hz.

.07 amps

All coils rated for continuous operation.

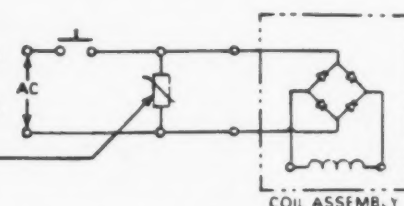
AC coils use an internal AC/DC rectifier.

PLEASE NOTE:

Coils contain a full wave bridge rectifier rated for reverse voltage peaks of 1000 Volts Maximum. This is adequate for most systems. If voltage transients in your system are greater than 1000 Volts P.I.V., voltage transient suppressors such as metal oxide varistors should be added in parallel with the coil.

SUPPRESSOR

115 VAC - USE
GE MOV-VP130A10
OR EQUAL
230 VAC - USE
GE MOV-VP250A20
OR EQUAL



LEAKAGE:

In closed position - Inlet to Outlet @ 3000 psi: 5 drops per minute maximum with 135 s.s.u. oil @ 100°F.

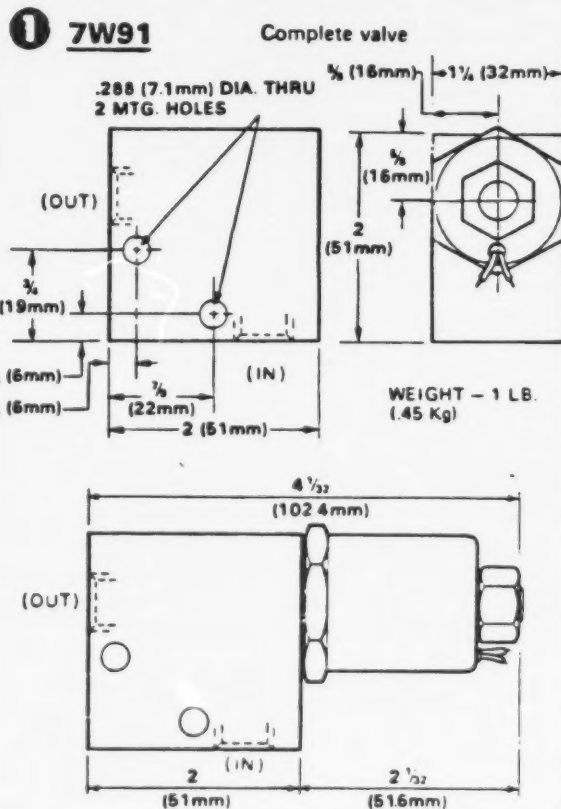
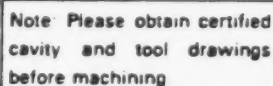
MATERIALS:

Cartridge housing, steel.
Valve body, hi strength wrought aluminum.
Internal parts, hardened steel, stainless steel.

**PILOT OPERATED, POPPET STYLE, TWO WAY VALVE
NORMALLY OPEN, NORMALLY CLOSED
FOR OIL - TO 5 G.P.M. (19 L/MIN), 3000 P.S.I. (210 bar)**

PART NUMBER EXAMPLE: HOW TO ORDER

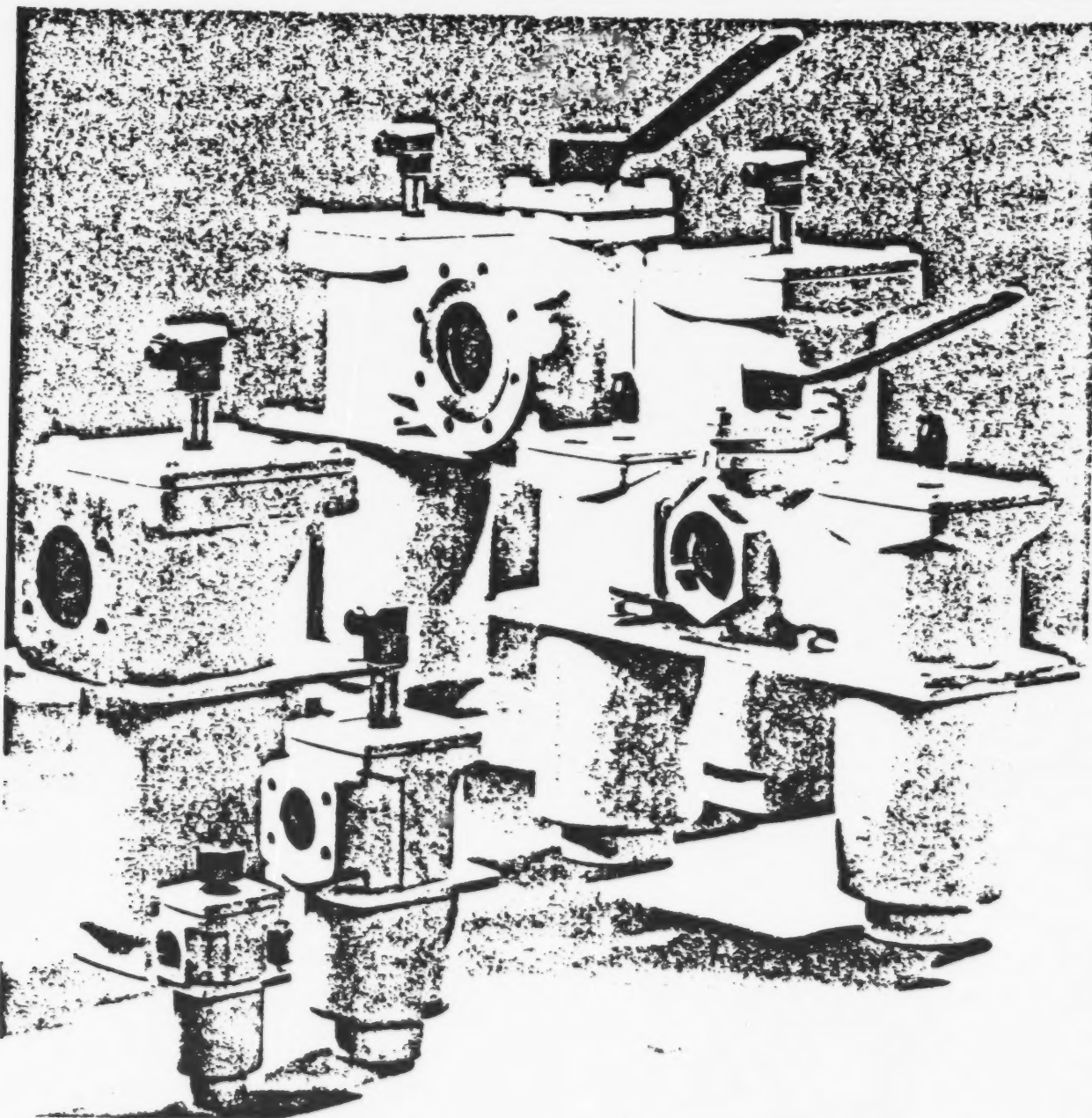
1 2 3 4 5 6



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Bethlehem, Pa. 18017
Telephone (215) 266-0100 · Telex 84 7328



IN-TANK RETURN LINE FILTERS SERIES RF





1. DESCRIPTION

1.1. ELEMENTS

1.1.1. Metal Fiber Elements (Cleanable)

The 4 *plus* 4 metal fiber element has the following 8 unique advantages:

- High contamination retention due to depth filtration.
- Constant high hold-back rate insures long filter life.
- Low flow resistance with compact design.
- Longer service life due to depth filtration.

plus

- High differential collapse pressure due to high inherent stability.
- Protection against corrosion by use of stainless steel filter material and zinc plated steel parts.
- High temperature resistance due to metal fiber element.
- Economical because of cleanable element.

1.1.2. Wire Mesh Element (Cleanable)

- High differential collapse pressure due to high inherent stability.
- High temperature resistance due to metal fiber element.
- Protection against corrosion by use of stainless steel filter material and zinc plated steel parts.
- Economical because of cleanable element.

1.1.3. Paper Fleece Element (Throw-away)

- High contamination retention due to depth filtration.
- Low flow resistance because no bonding agent is used in filter material.
- High inherent stability due to wire screen support on both sides of filter material.
- High temperature resistance as paper fleece is free of phenolic resin.

1.1.4. Betamicon Element of Inorganic Fibers (Throw-away)

- Excellent absorption of finest particles over a wide differential pressure range.
- High contamination retention due to large specific absorption area.
- Excellent chemical resistance is achieved by using epoxy resin in the process of impregnating and bonding of inorganic fibers.
- Protection against damage due to high burst pressure resistance (for example: during cold start-ups and differential pressure surges).

1.2. FILTER HOUSINGS

The in-tank return line filters type RF and RFD are suitable for direct mounting in oil reservoirs. The filters are designed so that pressure surges caused by sudden openings of the large control valves are absorbed without damage. A container for the purpose of trapping dirt surrounds the filter element. When the element is removed, the container is drawn out with it, so that any residual dirt is not allowed to flow back into the tank. The in-tank return line filter can be fitted with a mechanical or electrical clogging indicator.

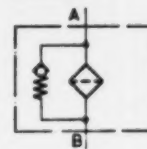
2. TECHNICAL DATA

2.1. GENERAL

2.1.1. Hydraulic Symbols In-tank Return Line Filter

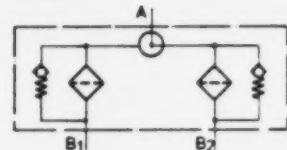
Single Filter

Model A



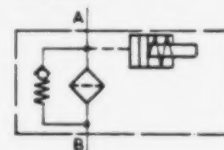
Double Filter

Model A

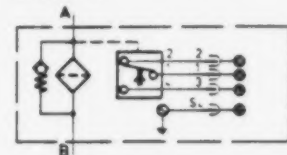


Filter with dirt clogging indicator

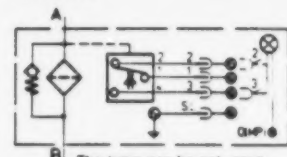
Model B



Model C

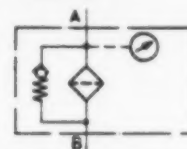


Model D

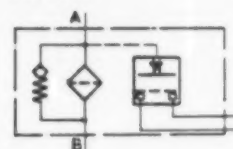


The lamp can be activated either on closing contact (3) or on opening contact (2)

Model E



Model F



2.1.2. Type Code (also ordering example)

RF V 160 G 10 D 1 . 1 / L 24 - V

Filter Type _____
 RF - In-Tank Return Line Filter
 RFD - In-Tank Dual Return Line Filter

Filter Material of Element _____
 BN - Betamicon N-Element
 V - Metal Fiber (4plus4) } max. Δp
 P - Paper } see 2.2.1.
 W - Wire Mesh

Size _____
 30 8 GPM
 60 16 GPM
 110 30 GPM
 160 48 GPM
 240 72 GPM
 330 90 GPM
 660 180 GPM
 950 285 GPM
 1300 380 GPM
 Nominal GPM Rating
 Note Viscosity and Application

Port Connection _____
 G - Threaded
 F - Flange } consult paragraph 2.1.6.

Filtration in Micron _____
 10 [Betamicon N (BN) consult paragraph 2.2.8.
 Metal Fiber (4plus4) (V)] Nominal
 Paper (P)
 25
 74 Wire Mesh (W)
 149
 (other micron ratings on request)

Type of Indicator _____
 A - without clogging indicator
 B - with visual clogging indicator
 C - with electrical clogging indicator
 D - with electrical and visual clogging indicator
 E - with manometer
 F - with pressure switch (up to 42 Volt only)
 See Clogging Indicator Brochure

Type Number _____
 1 - Standard connection
 2 - Reduced connection (only RF series) -
 3 - consult paragraph 2.1.6.

Modification Number _____

Supplementary Details _____
 L 24 - Lamp for 24 Volt
 L 48 - Lamp for 48 Volt
 L 110 - Lamp for 110 Volt
 L 220 - Lamp for 220 Volt
 D-Type clogging indicator only
 - 5 - NPT Threaded (RF only)
 - V - Viton Seals
 - T - Air Breather included (only RF 30)
 - 1 - Magnetic Strip (included in basket)
 12 - SAE Straight Thread (special order)

2.1.3. Design

In-Tank Return Line Filter

2.1.4. Mounting Method

Inline or base flange for reservoir mounting

2.1.5. Approximate Weight

		with element	without element		
		lbs.	kg	lbs.	kg
RF	30	0.9	0.4	0.7	0.3
RF	60	2.0	0.9	1.7	0.75
RF	110	2.4	1.1	2.0	0.9
RF	160	4.0	1.8	3.3	1.5
RF	240	5.0	2.3	4.0	1.8
RF	330	8.6	4.1	8.2	3.4
RF	660	44.0	20.0	41.0	18.5
RF	950	92.0	41.5	86.0	39.0
RF	1300	102.0	46.0	95.0	43.0
RFD	60	11.0	4.9	10.0	4.6
RFD	110	12.0	5.4	11.0	5.0
RFD	160	25.0	11.1	23.0	10.5
RFD	240	27.0	12.3	25.0	11.3
RFD	330	45.0	20.3	42.0	18.9
RFD	660	133.0	60.0	127.0	57.5
RFD	950	276.0	125.0	265.0	120.0
RFD	1300	315.0	143.0	302.0	137.0

2.1.6. Connection Size

RF	30	Type No. 1 = ½" NPT-N/A
RF	60	Type No. 1 = 1" NPT-SAE-16 Type No. 2 = ¾" NPT-SAE-12 Type No. 3 = ½" NPT-SAE- 8
RF	110	Type No. 1 = 1" NPT-SAE-16 Type No. 2 = ¾" NPT-SAE-12 Type No. 3 = ½" NPT-SAE- 8
RF	160	Type No. 1 = 1½" NPT-SAE-24 Type No. 2 = 1¼" NPT-SAE-20
RF	240	Type No. 1 = 1½" NPT-SAE-24 Type No. 2 = 1¼" NPT-SAE-20
RF	330	Type No. 1 = 2" NPT or SAE Flange (3000 PSI)
RF	660	Type No. 1 = 3" SAE Flange (500 PSI)
RF	950	Type No. 1 = 3½" SAE Flange (500 PSI)
RF	1300	Type No. 1 = 4" SAE Flange (500 PSI)
RFD	60	Type No. 1 = 1" NPT
RFD	110	Type No. 1 = 1" NPT
RFD	160	Type No. 1 = 1½" NPT
RFD	240	Type No. 1 = 1½" NPT
RFD	330	Type No. 1 = 2" NPT
RFD	660	Type No. 1 = 3" NPT
RFD	950	Type No. 1 = DIN Flange NW 80, ND 16
RFD	1300	Type No. 1 = DIN Flange NW 100, ND 16

2.1.7. Mounting Position

Vertical

2.1.8. Direction of Flow

Inlet: Side-Horizontal
 Outlet: Bottom-Vertical

2.2. HYDRAULIC DATA

2.2.1. Operating Pressure

RF - pmax. 435 PSI = 30 BAR
RFD - pmax. 232 PSI = 16 BAR
RF 30 - pmax. 145 PSI = 10 BAR

max. Δp for Element

Metal Fiber 4plus4:

1015 PSI = 70 BAR

Wire Mesh:

435 PSI = 30 BAR

Paper:

145 PSI = 10 BAR

Betamicon N:

435 PSI = 30 BAR

(according to ISO 2941)

2.2.2. Temperature Range

min ... max ... =

+14° F ... +212° F

-10° C ... +100° C

2.2.3. Fluid Compatibility

(Test data in accordance with ISO 2943)

2.2.4. Continuous Flow Stability according to ISO/DIS 3724

High continuous fatigue resistance is achieved by using heavy mechanical support on both sides of the filter media, and a filter media of high inherent stability.

2.2.5. Trip Pressure of Indicators

Δp = 29 PSI = 2 BAR

2.2.6. Cracking Pressure of By-pass Valve

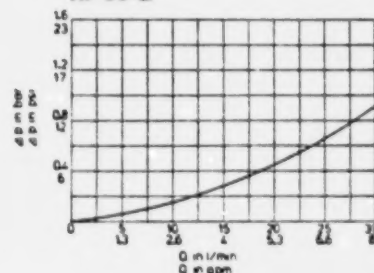
Δp = 43 PSI = 3 BAR

2.2.7. Δp -Q-Curves to ISO/DIS 3968.2 Class B

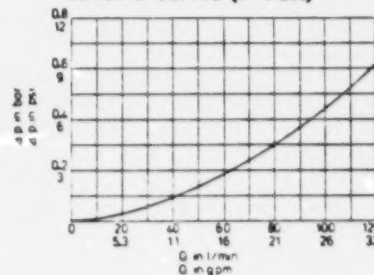
Housing Curves

Applicable for mineral oils with a specific gravity of 0.86 and a kinematical viscosity of 141 SSU. During turbulent flows, differential pressure changes in proportion to specific gravity. During laminar flows, differential pressure changes in proportion to specific gravity and viscosity.

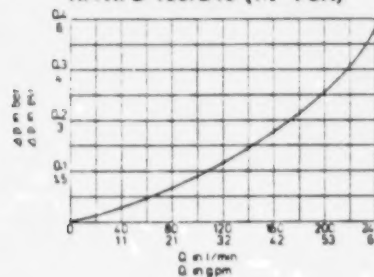
RF 30 G



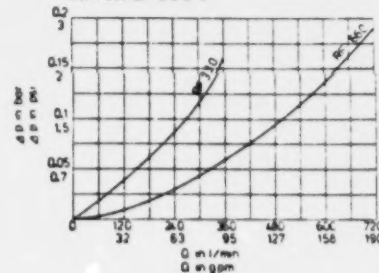
RF/RFD 60/110 (1" Port)



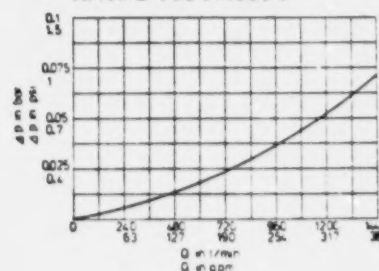
RF/RFD 160/240 (1 1/2" Port)



RF/RFD 330 (2" Port) RF/RFD 660 F

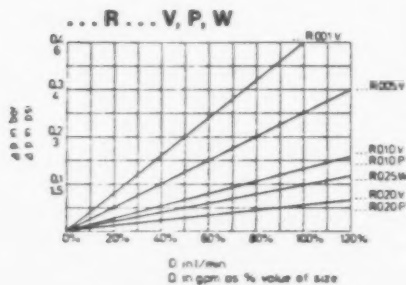


RF/RFD 950 F/1300 F



Element Curves

The element curves are based on mineral oil with a kinematical viscosity of 141 SSU. The differential pressure across the element changes proportionally to the viscosity.



To find ΔP of element, divide application flow by the proper conversion factor below to find percentage, then read ΔP from the chart above.

Conversion Factors

Size	Factor
30	7.9
60	15.8
110	29
160	42.2
240	63.3
330	87
660	174.1
950	251.3
1300	343.9

Application GPM
Conversion Factor = % Size

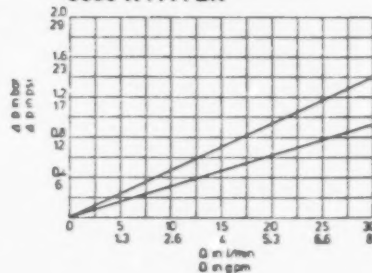
Example:

25 Wire Mesh, 60 GPM, Size 240

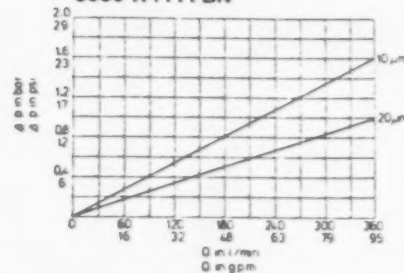
$\frac{60 \text{ GPM}}{63.3} = .947 = 95\% \text{ of Flow}$

95% = 1.5 PSI ΔP

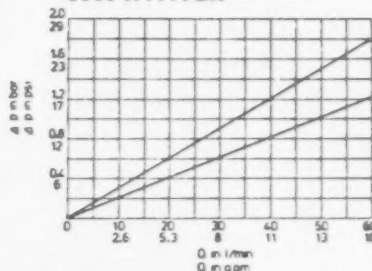
0030 R ... BN



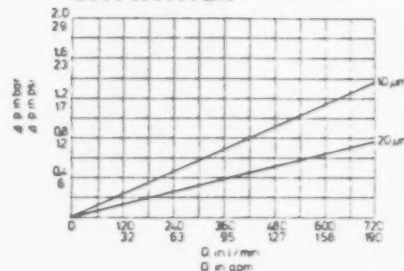
0330 R ... BN



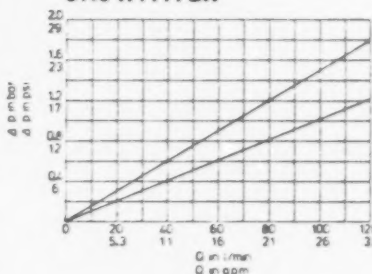
0060 R ... BN



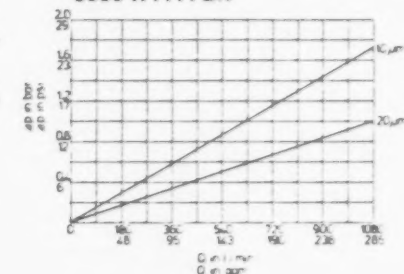
0660 R ... BN



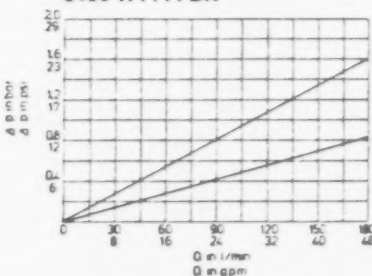
0110 R ... BN



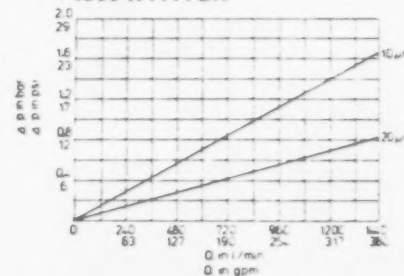
0950 R ... BN



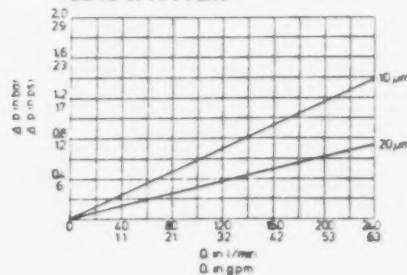
0160 R ... BN



1300 R ... BN



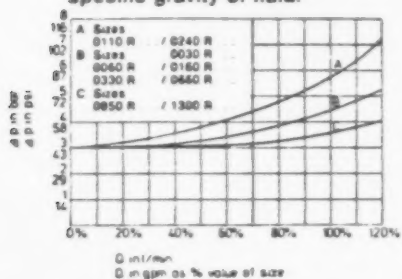
0240 R ... BN



By-pass Curves

These by-pass curves are for mineral oil with a specific gravity of 0.86.

The valve pressure differential changes in proportion to the specific gravity of fluid.



Total Differential Pressure for the Complete Filter

Total differential Pressure for the complete filter is established by adding housing differential pressure and clean element differential pressure.

2.2.8. Filtration Efficiency

Retention Rates for 4 plus 4, Wire Mesh and Paper Elements

This test involves a large amount of contaminants (ACFTD) being introduced during the beginning of the test with gradual separation of these particles by the filter over a one hour period.

The filter element must retain 90 - 95 % of the particles larger than the given micron rating.

Multi-Pass Filtration Efficiency Ratings to ISO/DIS 4572 for Betamicron-Elements

The allocation of the β_x -values to the filter element differential pressure is based on the cracking pressure of the differential pressure indicator and the by-pass valve.

The multi-pass data was determined on the factory test stand according to ISO/DIS 4572 (to maximum filter efficiency).

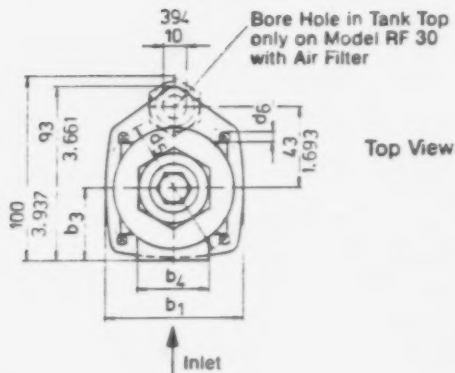
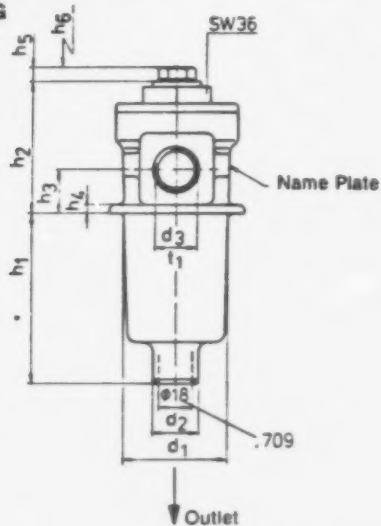
Filtration Quotients β_x dependent upon Δp across Element				
$\beta_x = \frac{\text{Particles upstream of Filter } \geq x \mu\text{m}}{\text{Particles downstream of Filter } \geq x \mu\text{m}}$				
β_x	Betamicron Element Type			
	... R 010 BN		... R 020 BN	
	$\Delta p = 30.45 \text{ PSI}$ 2.1 BAR	$\Delta p = 50.75 \text{ PSI}$ 3.5 BAR	$\Delta p = 30.45 \text{ PSI}$ 2.1 BAR	$\Delta p = 50.75 \text{ PSI}$ 3.5 BAR
β_3	1.4	1.4	-	-
β_4	1.9	1.9	-	-
β_5	4.6	4.4	-	-
β_6	13.3	12.1	-	-
β_{10}	55	44	2.5	2.2
β_{15}	> 1000	> 1000	15.2	13
β_{20}	-	-	72	63
β_{25}	-	-	900	> 1000
β_{30}	-	-	> 1200	∞
	$\beta_{100} \geq 100$	$\beta_{112} \geq 100$	$\beta_{200} \geq 100$	$\beta_{250} \geq 100$

2.2.9. Quality Control

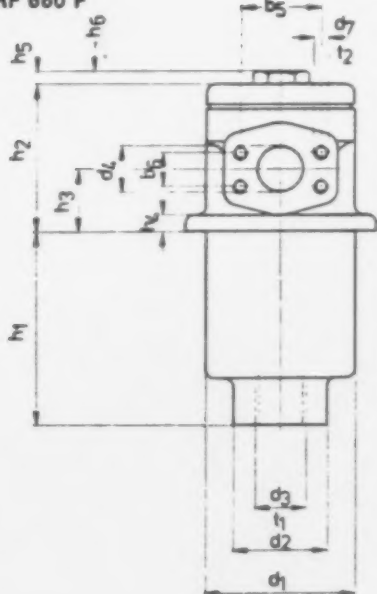
Continuous filtration efficiency tests and quality control by means of the bubble test to ISO 2942, guarantees highest quality standards.

3. DIMENSIONS: RF

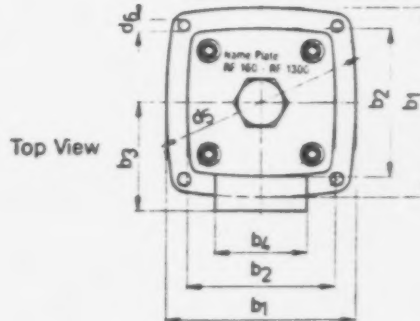
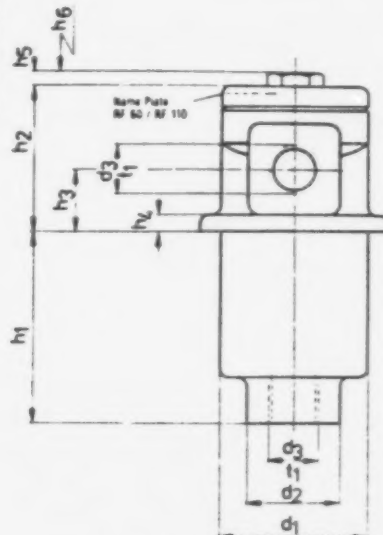
RF 30 G



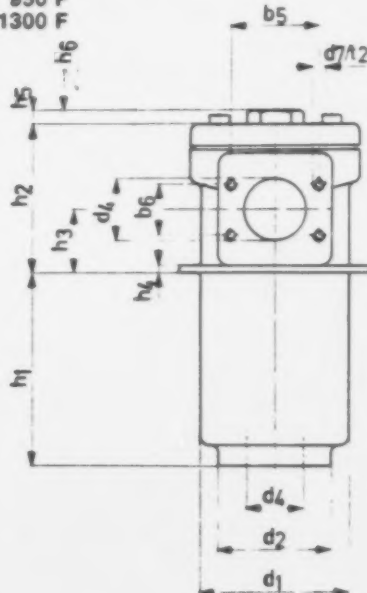
RF 330 F
RF 660 F



RF 60 G
RF 110 G
RF 160 G
RF 240 G
RF 330 G



RF 950 F
RF 1300 F

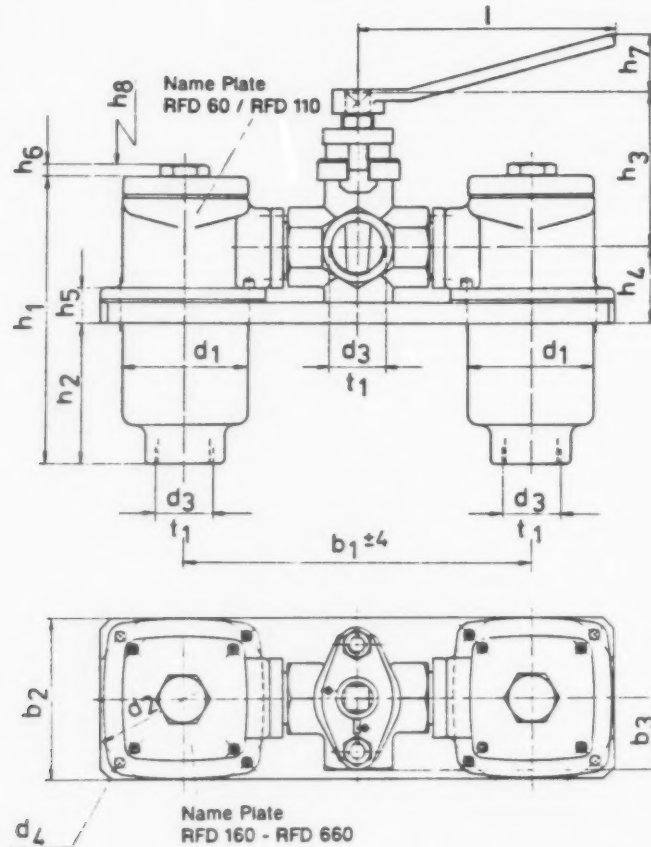


Type		b ₁	b ₂	b ₃	b ₄	b ₅	b ₆	ød ₁	d ₂	d ₃	ød ₄	ød ₅
RF 30 G...1.1	inch mm	2.795 71	- -	1.496 38	1.496 38	- -	- -	2.126 ø .945 54 ø 24	½ NPT R ½"	- -	- -	3.071 78
RF 60 G...1.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	1 NPT R 1"	- -	- -	3.937 100
RF 60 G...2.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	¾ NPT R ¾"	- -	- -	3.937 100
RF 60 G...3.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	1 NPT R 1"	- -	- -	3.937 100
RF 110 G...1.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	1 NPT R 1"	- -	- -	3.937 100
RF 110 G...2.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	¾ NPT R ¾"	- -	- -	3.937 100
RF 110 G...3.1	inch mm	3.543 90	2.874 73	1.890 48	1.772 45	- -	- -	2.835 ø 1.772 72 ø 45	¾ NPT R ¾"	- -	- -	3.937 100
RF 160 G...1.1	inch mm	4.724 120	3.898 99	2.598 66	2.283 58	- -	- -	3.858 ø 2.283 98 ø 58	1½ NPT R 1½"	- -	- -	5.315 135
RF 160 G...2.1	inch mm	4.724 120	3.898 99	2.598 66	2.283 58	- -	- -	3.858 ø 2.283 98 ø 58	1 NPT R 1"	- -	- -	5.315 135
RF 240 G...1.1	inch mm	4.724 120	3.898 99	2.598 66	2.283 58	- -	- -	3.858 ø 2.283 98 ø 58	1½ NPT R 1½"	- -	- -	5.315 135
RF 240 G...2.1	inch mm	4.724 120	3.898 99	2.598 66	2.283 58	- -	- -	3.858 ø 2.283 98 ø 58	1 NPT R 1"	- -	- -	5.315 135
RF 330 G...1.1	inch mm	5.984 152	5.000 127	3.346 85	- -	- -	- -	5.039 ø 2.992 128 ø 76	2 NPT R 2"	- -	- -	6.693 170
RF 330 F...1.1	inch mm	5.984 152	5.000 127	3.346 85	- -	3.071 78	1.693 43	5.039 ø 2.992 128 ø 76	2 NPT R 2"	1.968 50	- -	6.993 170
RF 660 F...1.1	inch mm	7.717 196	6.575 167	4.331 110	- -	4.193 106.5	2.441 62	6.575 ø 4.331 167 ø 111	3 NPT R 3"	3.150 80	- -	8.661 220
RF 950 F...1.1	inch mm	10.039 255	8.661 220	5.315 135	- -	4.752 120.7	2.756 70	7.874 □ 6.614 200 □ 168	- -	3.543 90	- -	11.417 290
RF 1300 F...1.1	inch mm	10.039 255	8.661 220	5.709 145	- -	5.126 130.2	3.071 78	7.874 □ 6.614 200 □ 168	- -	3.937 100	- -	11.417 290

Type		ød ₆	d ₇	h ₁	h ₂	h ₃	h ₄	h ₅	h ₆	t ₁	t ₂
RF 30 G...1.1	inch mm	.197 5	- -	3.504 89	2.638 67	.945 24	.197 5	.433 11	3.543 90	.551 14	- -
RF 60 G...1.1	inch mm	.217 5.5	- -	3.720 94.5	2.795 71	1.201 30.5	.315 8	.433 11	3.543 90	.709 18	- -
RF 60 G...2.1	inch mm	.217 5.5	- -	3.720 94.5	2.795 71	1.201 30.5	.315 8	.433 11	3.543 90	.630 16	- -
RF 60 G...3.1	inch mm	.217 5.5	- -	3.720 94.5	2.795 71	1.201 30.5	.315 8	.433 11	3.543 90	.630 16	- -
RF 110 G...1.1	inch mm	.217 5.5	- -	6.378 162	2.795 71	1.201 30.5	.315 8	.433 11	6.299 160	.709 18	- -
RF 110 G...2.1	inch mm	.217 5.5	- -	6.378 162	2.795 71	1.201 30.5	.315 8	.433 11	6.299 160	.630 16	- -
RF 110 G...3.1	inch mm	.217 5.5	- -	6.378 162	2.795 71	1.201 30.5	.315 8	.433 11	6.299 160	.630 16	- -
RF 160 G...1.1	inch mm	.256 6.5	- -	4.843 123	3.386 86	1.457 37	.315 8	.433 11	5.118 130	.787 20	- -
RF 160 G...2.1	inch mm	.256 6.5	- -	4.843 123	3.386 86	1.457 37	.315 8	.433 11	5.118 130	.787 20	- -
RF 240 G...1.1	inch mm	.256 6.5	- -	7.165 182	3.386 86	1.457 37	.315 8	.433 11	7.480 190	.787 20	- -
RF 240 G...2.1	inch mm	.256 6.5	- -	7.165 182	3.386 86	1.457 37	.315 8	.433 11	7.480 190	.787 20	- -
RF 330 G...1.1	inch mm	.354 9	- -	5.551 141	5.118 130	2.362 60	.394 10	.433 11	7.087 180	1.063 27	- -
RF 330 F...1.1	inch mm	.354 9	½ UNC M 12	5.551 141	5.118 130	2.362 60	.394 10	.433 11	7.087 180	1.063 27	.906 23
RF 660 F...1.1	inch mm	.551 14	¾ UNC M 14	9.689 246	6.496 65	3.150 80	.394 10	.433 11	12.598 320	1.260 32	.984 25
RF 950 F...1.1	inch mm	.709 18	1 UNC M 16	17.000 254	7.677 195	3.622 92	.394 10	.433 11	13.780 350	- -	.866 22
RF 1300 F...1.1	inch mm	.709 18	1 ½ UNC M 16	13.189 335	9.370 238	4.646 118	.394 10	.433 11	18.110 460	- -	.984 25

DIMENSIONS RFD:

RFD 60 G
RFD 110 G
RFD 160 G
RFD 240 G
RFD 330 G
RFD 660 G



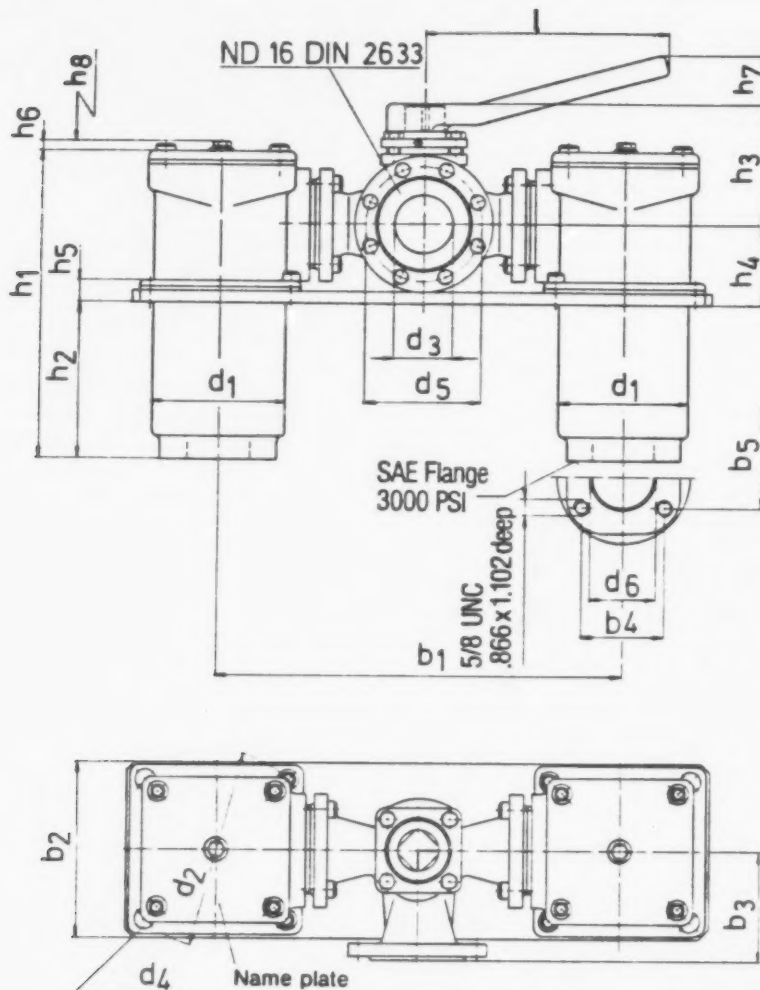
Type		$b_1 \pm a^*$	b_2	b_3	ϕd_1	ϕd_2	d_3	ϕd_4	h_1	h_2
RFD 60 G	inch mm	7.717 196	3.543 90	1.575 40	2.835 72	3.937 100	1 NPT R 1"	.217 5.5	6.496 165	3.110 79
RFD 110 G	inch mm	7.717 196	3.543 90	1.575 40	2.835 72	3.937 100	1 NPT R 1"	.217 5.5	9.173 233	5.787 147
RFD 160 G	inch mm	10.315 262	4.724 120	2.165 55	3.858 98	5.315 135	1½ NPT R 1½"	.256 6.5	8.228 209	4.005 103
RFD 240 G	inch mm	10.315 262	4.724 120	2.165 55	3.858 98	5.315 135	1½ NPT R 1½"	.256 6.5	10.551 268	6.378 162
RFD 330 G	inch mm	12.992 330	5.948 152	2.677 68	5.039 128	6.693 170	2 NPT R 2"	.354 9	10.669 271	5.039 128
RFD 660 G	inch mm	16.496 419	7.717 196	3.465 88	6.575 167	8.661 220	3 NPT R 3"	.551 14	16.181 411	9.134 232

* $a = 0.157 \text{ inch} = 4 \text{ mm}$

Type		h_3	h_4	h_5	h_6	h_7	h_8	l	l_1
RFD 60 G	inch mm	3.543 90	1.772 45	.906 23	.433 11	1.772 45	3.543 90	5.118 130	.551 14
RFD 110 G	inch mm	3.543 90	1.772 45	.906 23	.433 11	1.772 45	6.299 160	5.118 130	.551 14
RFD 160 G	inch mm	4.764 121	2.205 56	1.102 28	.433 11	2.165 55	5.118 130	7.087 180	.669 17
RFD 240 G	inch mm	4.764 121	2.205 56	1.102 28	.433 11	2.165 55	7.480 190	7.087 180	.669 17
RFD 330 G	inch mm	5.433 138	2.874 73	.906 23	.433 11	3.150 80	7.087 180	9.055 230	.787 20
RFD 660 G	inch mm	6.890 175	3.622 92	.906 23	.433 11	3.976 100	12.598 320	12.592 330	.984 25

DIMENSIONS RFD:

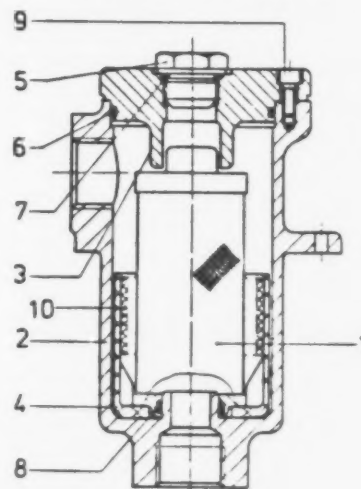
RFD 950 F
RFD 1300 F



Top View

4. SPARE PARTS: RF

Reference:
Proper function is only
guaranteed when using
HYCON replacement parts.



Type		$b_1 \pm a^*$	b_2	b_3	b_4	b_5	ϕd_1	ϕd_2
RFD 950 F	inch	23.071	10.039	6.220	4.752	2.756	7.874	11.417
	mm	586	255	158	120.7	70	200	290
RFD 1300 F	inch	25.433	10.039	7.008	5.126	3.071	7.874	11.417
	mm	646	255	178	130.2	78	200	290
* $a = .197 \text{ inch} = 5 \text{ mm}$								
Type		ϕd_3	ϕd_4	ϕd_5	ϕd_6	h_1	h_2	h_3
RFD 950 F	inch	3.150	.709	6.299	3.543	17.716	9.291	7.008
	mm	80	18	160	90	450	236	178
RFD 1300 F	inch	3.937	.709	3.987	3.937	22.559	12.716	9.055
	mm	100	18	180	100	573	323	230
Type		h_4	h_5	h_6	h_7	h_8	l	
RFD 950 F	inch	4.331	1.181	.433	3.937	13.779	12.992	
	mm	110	30	11	100	350	330	
RFD 1300 F	inch	5.157	.945	.433	4.921	18.110	15.354	
	mm	131	24	11	125	460	390	

Item	Description	RF 30	RF 60	RF 110	RF 160	RF 240
1	Element 10 μ m	4 plus 4	0030R010V	0060R010V	0110R010V	0160R010V
	Element 20 μ m		0030R020V	0060R020V	0110R020V	0160R020V
	Element 25 μ m		0030R025W	0060R025W	0110R025W	0160R025W
	Element 74 μ m		0030R074W	0060R074W	0110R074W	0160R074W
	Element 149 μ m		0030R149W	0060R149W	0110R149W	0160R149W
	Element 10 μ m		0030R010P	0060R010P	0110R010P	0160R010P
	Element 20 μ m		0030R020P	0060R020P	0110R020P	0160R020P
	Element 10 μ m		0030R010BN	0060R010BN	0110R010BN	0160R010BN
	Element 20 μ m	Betamicon N	0030R020BN	0060R020BN	0110R020BN	0160R020BN
	Element 20 μ m		0030R020BN	0060R020BN	0110R020BN	0160R020BN
2	Housing	1	1	1	1	1
3	Lid	1	1	1	1	1
4	Contamination Retainer	1	1	1	1	1
5	Plug	1	1	1	1	1
6	O-Ring	1	1	1	1	1
		57.2 x 3	59 x 3	59 x 3	80 x 4	80 x 4
7	O-Ring	1	1	1	1	1
		18 x 2.5	18 x 2.5	18 x 2.5	18 x 2.5	18 x 2.5
8	O-Ring	1	1	1	1	1
		12.37 x 2.62	22 x 3.5	22 x 3.5	34 x 3.5	34 x 3.5
9	Socket Head Cap Screw	—	4	4	4	4
			3/16 x 5/8	3/16 x 5/8	1/4 x 5/8	1/4 x 5/8
10	Magnetic Strip (on request)	1	1	1	1	1

Item	Description	RF 330	RF 660	RF 950	RF 1300
1	Element 10 μ m	4 plus 4	0330R010V	0660R010V	0950R010V
	Element 20 μ m		0330R020V	0660R020V	0950R020V
	Element 25 μ m		0330R025W	0660R025W	0950R025W
	Element 74 μ m		0330R074W	0660R074W	0950R074W
	Element 149 μ m		0330R149W	0660R149W	0950R149W
	Element 10 μ m		0330R010P	0660R010P	0950R010P
	Element 20 μ m		0330R020P	0660R020P	0950R020P
	Element 10 μ m		0330R010BN	0660R010BN	0950R010BN
	Element 20 μ m	Betamicon N	0330R020BN	0660R020BN	0950R020BN
	Element 20 μ m		0330R020BN	0660R020BN	0950R020BN
2	Housing	1	1	1	1
3	Lid	1	1	1	1
4	Contamination Retainer	1	1	1	1
5	Plug	1	1	1	1
6	O-Ring	1	1	1	1
		105 x 5	142 x 6	175 x 5	175 x 5
7	O-Ring	1	1	1	1
		18 x 2.5	18 x 2.5	18 x 2.5	18 x 2.5
8	O-Ring	1	1	1	1
		48 x 3	68 x 5	96 x 6	96 x 6
9	Socket Head Cap Screw	4	4	4	4
		5/16 x 5/8	1/2 x 3/4	5/8 x 1 1/4	5/8 x 1 1/4
10	Magnetic Strip (on request)	1	1	1	1

O-Ring dimensions in millimeters

REXROTH

BETHLEHEM, PA 18018

**ENGINEERING
DATA SHEET****DIRECTIONAL CONTROL VALVE
WE 10 (1/2") A.C. Sol.***Solenoid Direct Operated...Subplate Mounting*

Mounting to ANSI D02

5000 PSI (340 bar)

26 GPM (100 l/min)

RA**RA 23332**

ISSUED 8-1-79

REVISED 3-81



Type 4 WE 10 .. 10/L W 220-50 NDL

4 WE 10 .. 10/L W 220-50NZ4

4 WE 10 .. 10/L W 220-50NZ5

4 WE 10 .. 10/L W 220-50NDZL

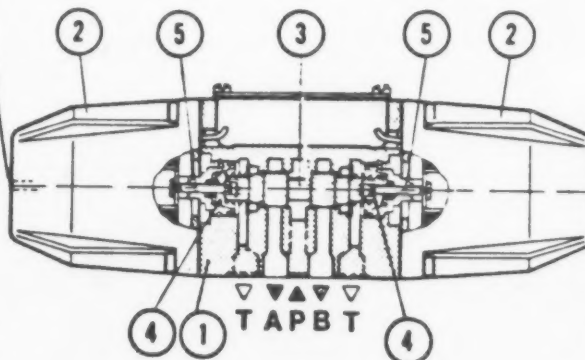
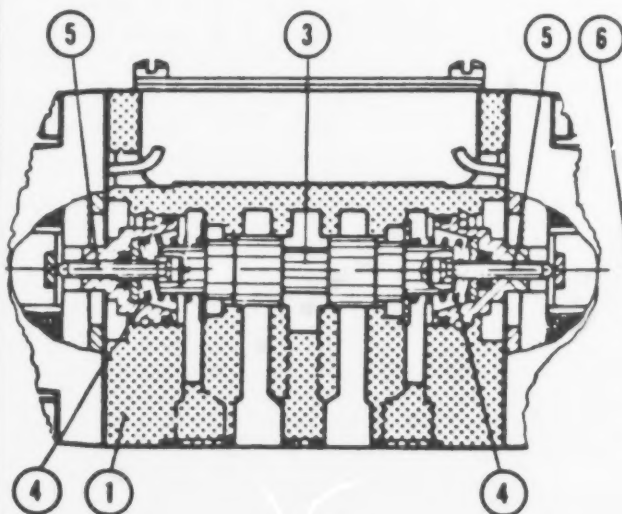
- Direct operating directional spool valve, solenoid operated
- AC air gap solenoids
- Available with or without manual solenoid override
- Electrical connection as single or central connection
- Complete range of spools available

DESCRIPTION OF FUNCTION, SECTION VIEW

GENERAL DESCRIPTION... The 4-way directional control valve is used in a hydraulic circuit to control the direction of motion of a hydraulic cylinder or motor. The command signal is electric. The WE 10 valve is direct acting, in that the solenoid (2) forces act directly on the spool (3) through a push pin (5). Three position valves, in addition to controlling forward and reverse motion, have a center or neutral position. The flow configuration in the center position

is determined by the spool selected. This center position is achieved when the solenoids are de-energized. Centering springs (4) center the spool (3) in the valve body (1).

Pushbutton manual overrides (6) allow the manual operation of the valve in the absence of electrical power. Indicator lights are wired parallel to the solenoid to indicate the electric signal to the solenoid. Indicator lights are an Optional Feature.



1. Valve Body
2. Solenoid
3. Spool

4. Centering Spring
5. Push Pin
6. Manual Override (one ea. end)

THE REXROTH CORPORATION, BETHLEHEM, PENNSYLVANIA 18018 • 215-694-8300

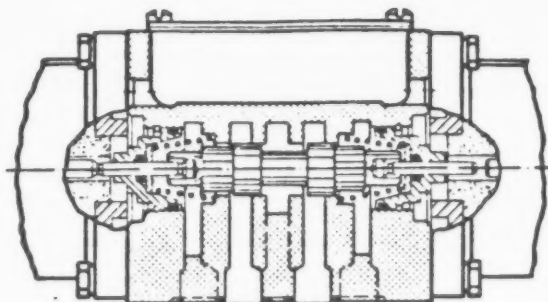
REXROTH

200 THE REXROTH CORPORATION, BETHLEHEM, PA 18018

OPTIONAL FEATURE "O" Without Springs

The double solenoid, two position option without spool centering springs, is available with spools "C" and "D" only. This no spring version is used for high cycling applications.

As there are no springs in this valve, it is recommended that the solenoid be continuously energized and that the valve is mounted horizontally; this prevents spool drift.

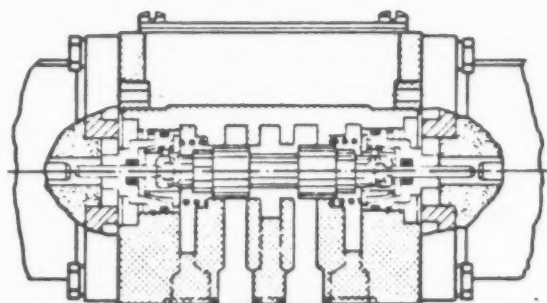


Type 4 WE 10 D 10/LO ..

OPTIONAL FEATURE "OF" Detented and Without Springs

This optional feature is a detented version of the double solenoid, two position option without spool centering springs. It is available with spools "C" and "D" only. The detented version is used in low cycling applications which greatly extends the life of the solenoid. The solenoid requires a short time cycle as the spool will hold its position when the detent is in place. Positioning of the spool requires approximately a time cycle of 100 MS.

As the spool position is held by the detent, continuous energizing of the solenoid is not necessary and the mounting position of the valve is optional.



Type 4 WE 10 D 10/LOF ..

OPTIONAL FEATURE "B" Throttle Orifice Insert

In applications where high flows are encountered from the pump or accumulators systems, flows could exceed the allowable flow for the valve. Excess flows can cause valve malfunctions and overloading of the solenoid, or the springs will not return the spool for the next cycle.

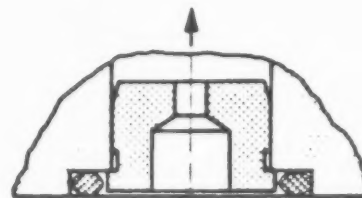
To avoid valve malfunctions, due to excess flows, three orifice sizes are available and mounted in the valve's pressure port.

Available Orifices

Ordering Code 808 Orifice Diameter 0.031" (0.8mm)

Ordering Code 810 Orifice Diameter 0.039" (1.0mm)

Ordering Code 813 Orifice Diameter 0.047" (1.2mm)



Type 4 WE 10 .. 10/L .. B ..

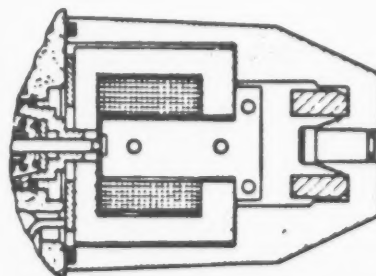
SOLENOIDS

Solenoids used for the WE 10 Design - Series 10 valves are air gap solenoids and operated with A.C. electrical power.

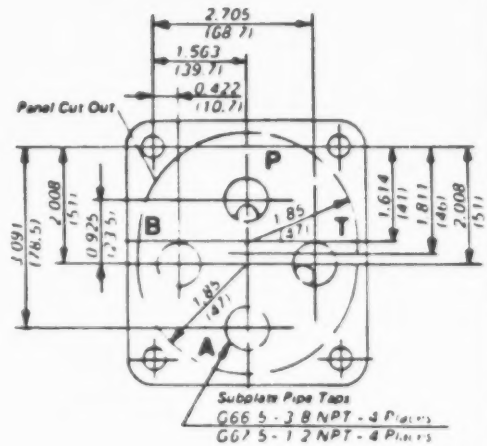
This solenoid is suited for operation in most atmospheres as it is fully encapsulated and treated against fungus. This provides protection and assures long service life. A seal is provided between the valve body and the solenoid housing. The manual override has an O-ring seal.

Electrical connections are made through the valve body to a terminal strip. As an optional feature, plug-in connections are available.

- ... Fast response - 30 MS.
- ... No special electrical contact protection required at the relay or pushbutton.
- ... Fully encapsulated to prevent entry of foreign materials.



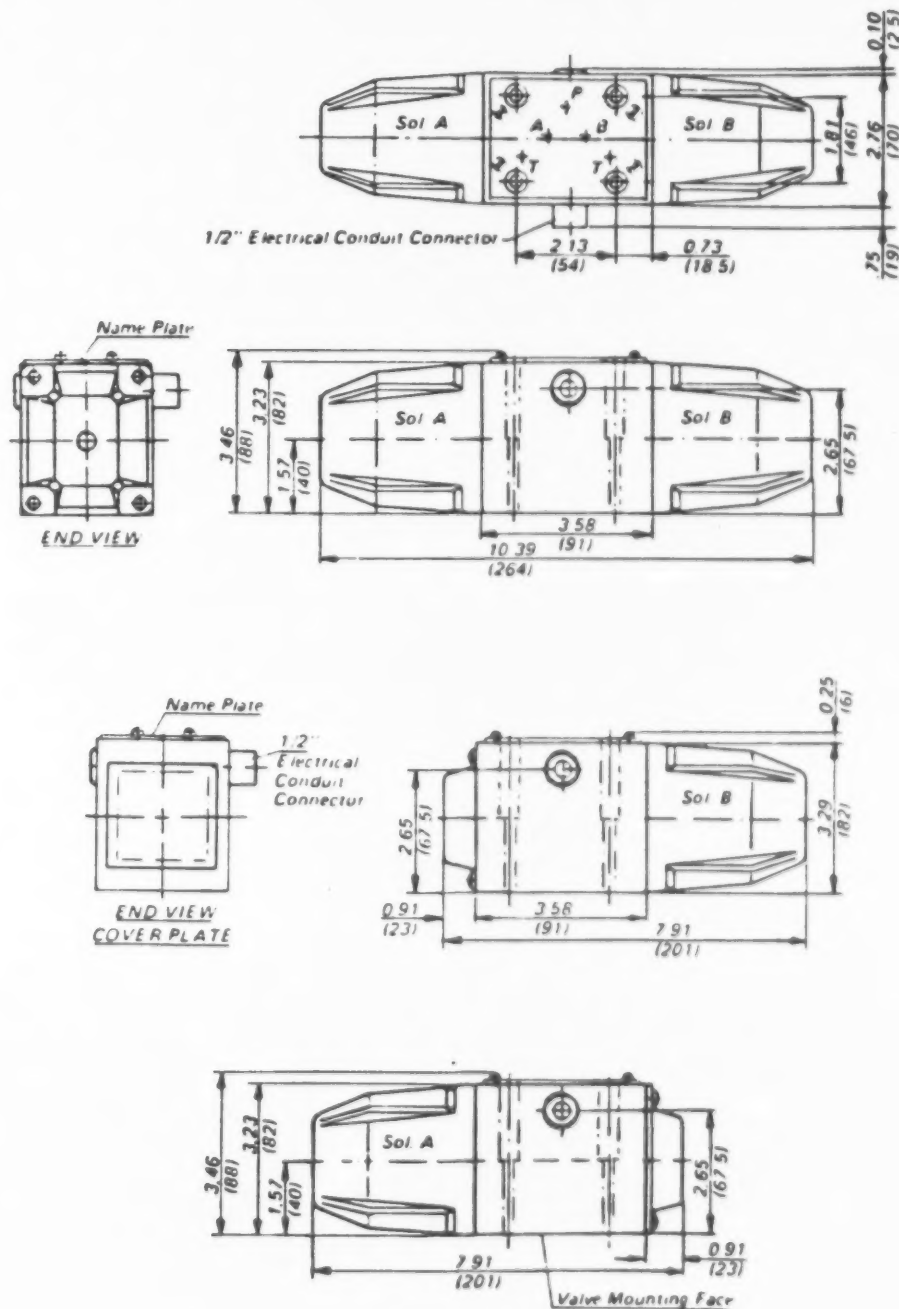
**SUBPLATE (Piping Connections) G66/5 (3/8" NPT)
and G67/5 (1/2" NPT)**



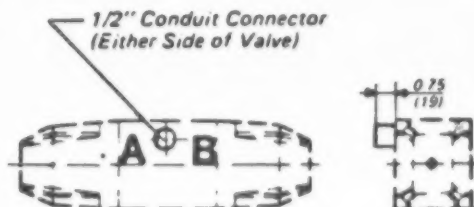
Technical drawing of a subplate showing dimensions and labels:

- Panel Cut Out
- Dimensions: 326.0, 182.21, 0.110, 12.81, 1.562, 139.71, 0.77, 119.51, 1.87, 146.1, 2.85, 172.51
- Labels: A, B, P, T
- Subplate Pipe To 7/8" 3/4 NPT & Places
- 1.03 Rad (26) 4 Places

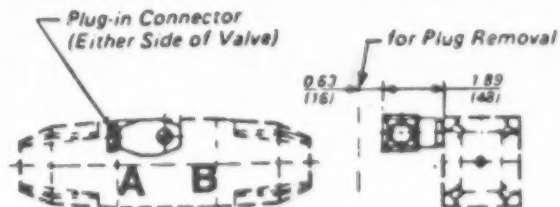
DOUBLE AND SINGLE A.C. AIR GAP SOLENOID VALVE (Standard)



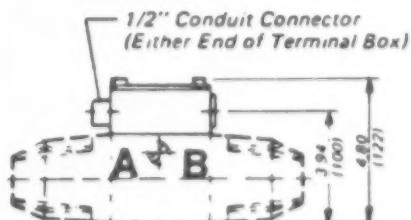
STANDARD Electrical Connection in Valve Body
ORDERING CODE "Omit" for Standard Connections



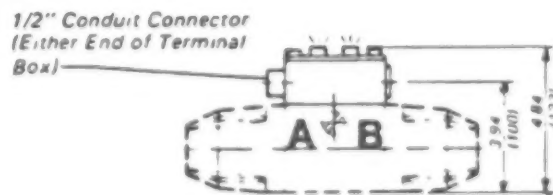
OPTIONAL FEATURE - Electrical Plug-in
ORDERING CODE "Z"



OPTIONAL FEATURE -
Electrical Connection in Top Terminal Box
ORDERING CODE "D"

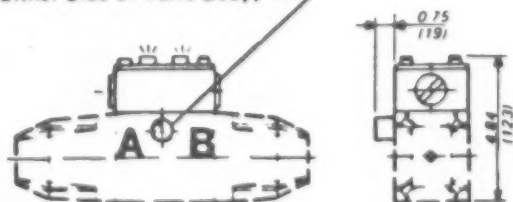


OPTIONAL FEATURE - Electrical Connections &
Pilot Lights in Top Terminal Box
ORDERING CODE "DL"



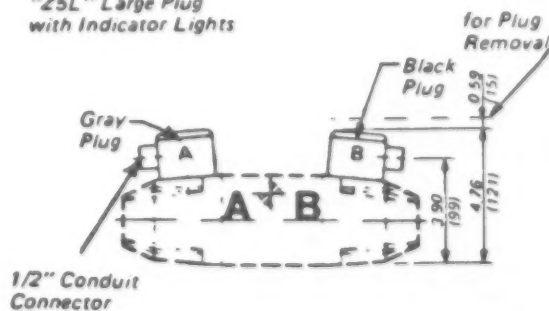
OPTIONAL FEATURE -
Electrical Connection in Valve Body Top Terminal Box
with Lights
ORDERING CODE "L"

1/2" Conduit Connector
(Either Side of Valve Body)



OPTIONAL FEATURE - Large Electrical Plug in
On The Solenoid
ORDERING CODE:

"Z5" Large Plug
 "Z5L" Large Plug
 with Indicator Lights



NO. OF WORKING PORTS

3 = 3 way
4 = 4 way

OPERATOR

E = Solenoid

SIZE

10 = 1/2"

SPOOL

See chart below

DESIGN SERIES

RETURN OPERATOR

O = Without spring return, w/o detent
OF = Without spring return, with detent

SOLENOIDS

L = Air gap
A = Wet pin

4 WE 10 C 10/OF L W220-50 N DL B08 V/5

SEALS

Omit = Buna-N
V = Viton

OMIT

= Without cartridge throttle

B08

= Throttle dia. 0.8 mm

B10

= Throttle dia. 1.0 mm

B12

= Throttle dia. 1.2 mm

ELECTRICAL CONNECTORS

Refer to Page 5

MANUAL OVERRIDE

Omit = Not required

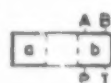
N = With manual override

VOLTAGES

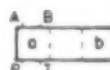
Omit = 120-60 AC

W = voltage + frequency for all AC

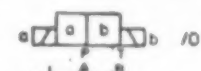
G = voltage for all DC



= A



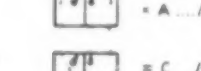
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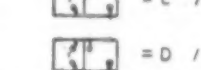
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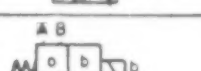
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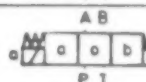
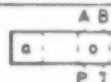
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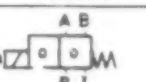
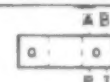
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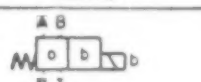
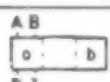
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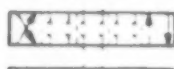
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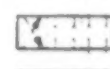
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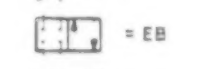
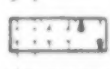
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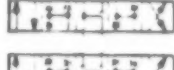
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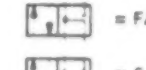
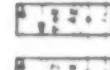
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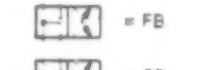
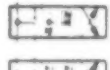
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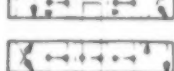
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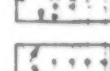
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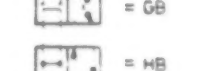
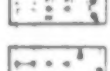
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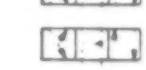
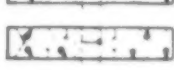
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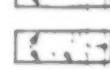
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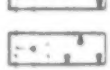
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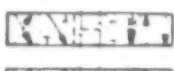
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= LA



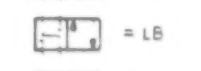
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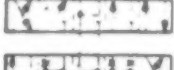
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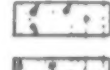
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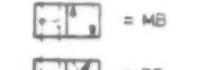
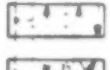
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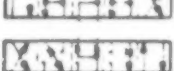
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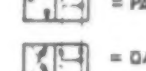
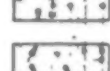
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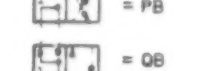
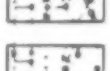
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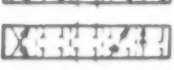
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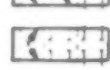
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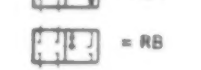
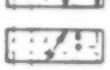
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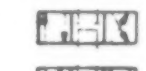
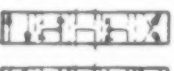
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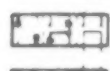
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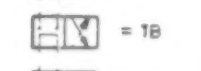
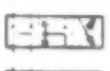
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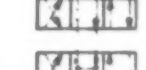
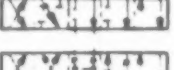
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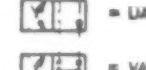
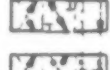
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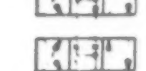
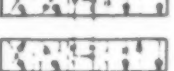
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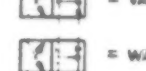
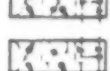
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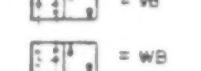
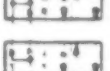
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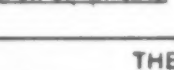
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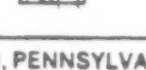
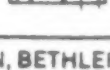
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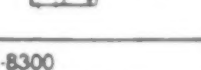
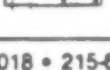
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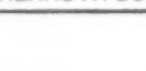
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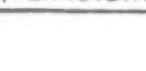
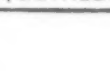
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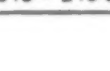
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= W

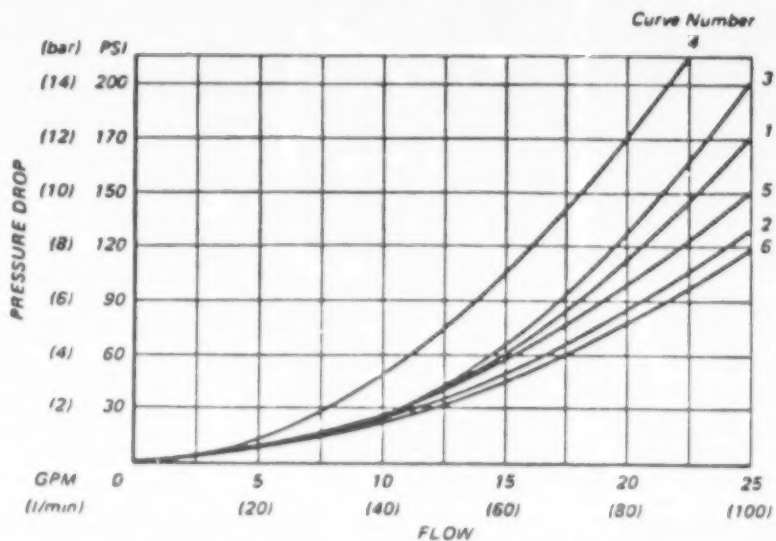


= LA



= HB

Curve No. 4 for "R" Spool - Ports A-B with Solenoid B Energized
Curve No. 4 for "G" Spool - Ports P-T Spool in Center Position



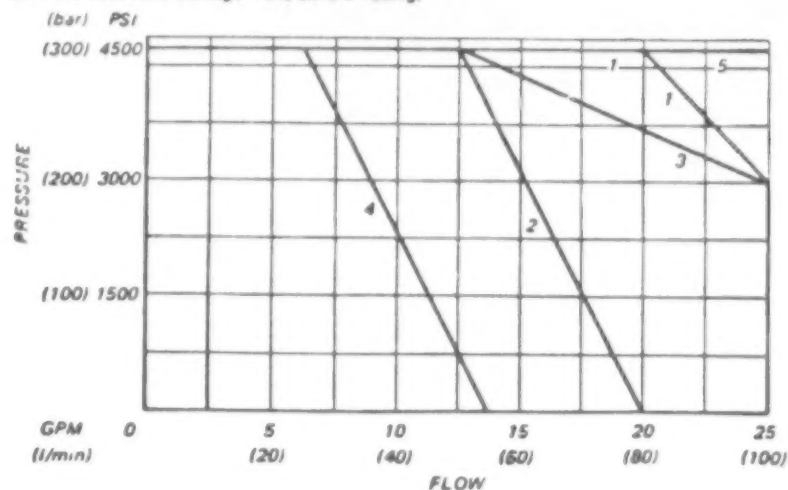
CURVE SELECTION CHART

Spool Type	Flow Direction			
	P-A	P-B	A-T	B-T
A	1	1		
B	1	1		
C	3	3	2	2
D	3	3	2	2
E	1	1	2	2
F	1	1	2	2
G	5	5	3	3
H	1	1	2	2
J	1	1	6	6
L	3	1	6	2
M	1	1	2	2
P	1	1	2	2
Q	1	1	2	2
R	3	3	2	3
T	5	5	3	3
U	3	1	6	2
V	1	1	2	2
W	1	1	2	2
Y	3	3	2	2

NOTE: To maintain optimum efficiency and trouble free spool shifting, it is recommended to use a full flow filtration of 25 microns or less. This filtration will avoid silt in the flow passages which could limit the maximum flow capacity of the valve. Flow data as shown applies to two directional flows. If only one flow direction, as in the case when Port A or B is plugged, the flow is reduced from that as shown.

VALVE PERFORMANCE DATA

Flow based on pressure tests made with warm oil and the solenoid voltage 10% below rating.



CURVE SELECTION CHART

Performance Curve	Spool Types
1	C, D, E H, L, V, Y
2	F, G, P, R, T
3	J, M, Q, U, W
4	A, B
5	C/O, D/O

HYDRAULIC DATA

Operating Pressure Port A, B, P PSI	5000 PSI (315 bar)
Port T PSI	2300 PSI (160 bar)
With spool Types A and B, Port T must be used as drain port, when operating pressure is in excess of 2300 PSI (160 bar)	
Flow	Up to 26 GPM (100 l/min)
Flow Section (Switching Position O)	Spool Type Q 6% of Nominal Section
Hydraulic Medium	Spool Type W 3% of Nominal Section
Fluid Temperature Range	Petroleum Based Hydraulic Fluids
Viscosity Range	-20°F (-30°C) to +160°F (+70°C)
Weight	35 SSU (2.8cSt) to 1750 SSU (380cSt)
Valve With 1 Solenoid	8.4 lbs. (3.8 kg)
Valve With 2 Solenoids	10.6 lbs. (4.8 kg)
Subplates	3/8" NPT 5 lbs. (2.3 kg)
	1/2" NPT 5 lbs. (2.3 kg)
	3/4" NPT 6 lbs. (2.7 kg)

ELECTRICAL DATA

Voltages Available	42, 110, 127, 220 (with 50 Hz); 120, 220 (with 60 Hz)
Holding Current	64 VA
In-rush Current	430 VA
Duty Cycle	DB
Switching Time, On	30 Milliseconds
Switching Time, Off	30 Milliseconds
Ambient Temperature	+120°F (+50°C)
Coil Temperature	+300°F (+150°C)
Switching Frequency	7200 Cycles p/hr.

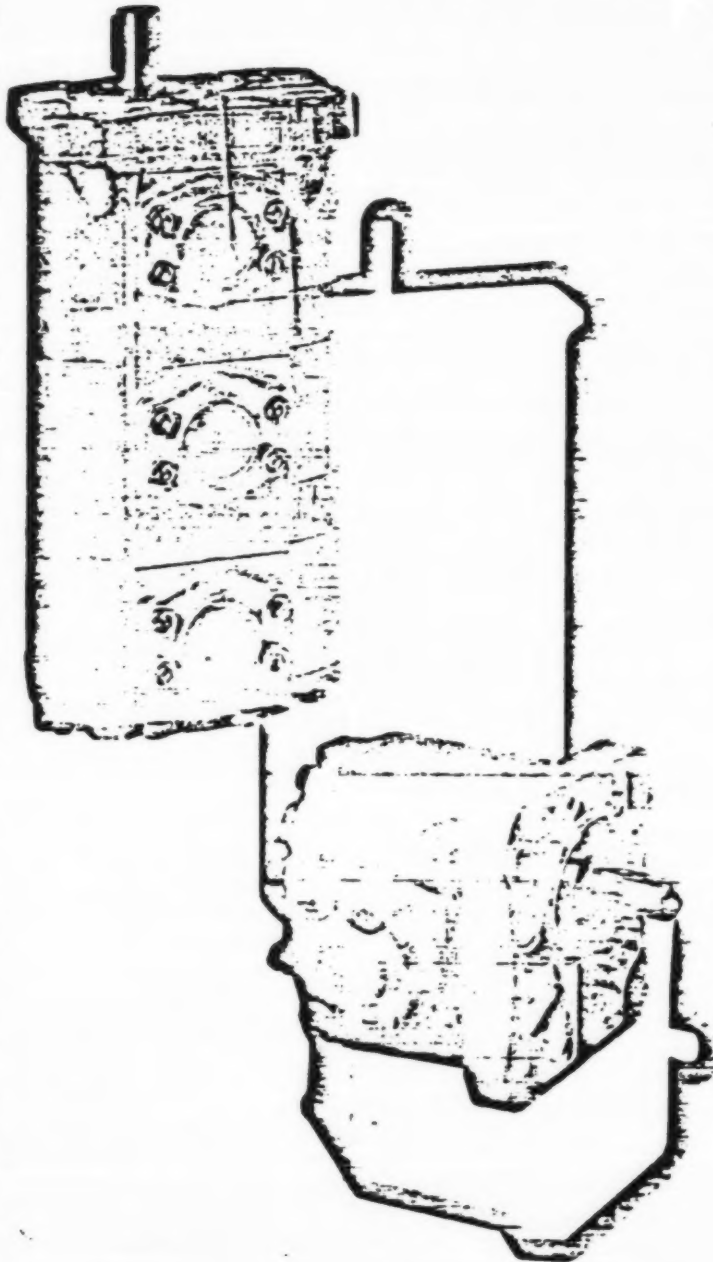
For application to other specifications, please consult us.

CONSTRUCTION — FABRICATION

FRANÇAIS

de pompes et moteurs hydrauliques à
engrenage à très hautes performances

→ DIVISEUR DE DÉBIT



* POMPES A ENGRENAGE

31 modèles en 4 séries
capacités: 1 à 250 cm³/t

* POMPES MULTICORPS

500 combinaisons de pompes double corps.
Des milliers de combinaisons en version
pompes triples et quadruples corps

* POMPES AVEC MULTIPLICATEURS

pour prise de force sur tracteur

* MOTEURS HYDRAULIQUES
A ENGRENAGE

- RAPIDES - 31 modèles
capacité 1 à 250 cm³/t
- SEMI-RAPIDES - 16 à 1000 cm³/t
- LENTS - 85 à 2880 cm³/t
- TRÈS LENTS - 1000 à 5300 cm³/t

* GROUPES ÉLECTRO-POMPES

courant alternatif 0,5 à 100 kW

* GROUPES ÉLECTRO-POMPES

courant continu 12 - 24 - 36 - 48 volts
unités complètes pour équipements mobiles

* VALVES HYDROSTATIQUES

débit 5 à 70 l/mn - 30 à 160 l/mn - 100 à 320 l/mn

* CLAPETS ANTI-RETOUR

débit 10 à 350 l/mn

* TÊTE DE FILTRATION

débit 5 à 90 l/mn

* CRÉPINES D'ASPIRATION

débit 1 à 500 l/mn

* RÉSERVOIRS POUR CIRCUITS
HYDRAULIQUES

capacité 7 - 10 - 20 - 30 - 40 - 80 litres

HYDROPERFECT-INTERNATIONAL

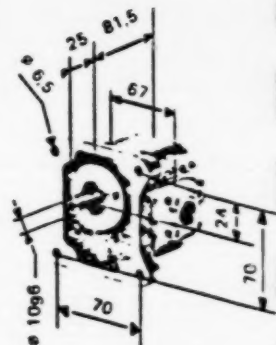
26. Rue Condorcet - Z. I. 94430 CHENNEVIÈRES - Tél. 933 60-22 - Télex 691910 F

POMPES

MOTEURS

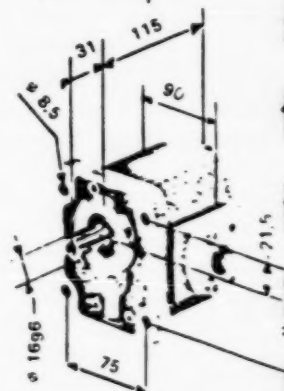
SERIE 1

MODELE	CAPACITE CM ³ /T	PRESSION (BARS)		VITESSE (T/MN)		DEBIT L/MN A 1500 T/MN	MASSE KG	VITESSE T/MN		PRESSION MAXI	COUPLE N/MN 100 BARS
		ECO	SAPHIR	MINI	MAXI			MINI	MAXI		
1001	1	250	400	1200	8000	1.5	0.9	1200	8000	200	0.10
1002	2	250	400	1000	8000	3	0.9	1000	8000	200	0.24
1003	3	250	400	1000	7000	4.5	0.9	1000	7000	200	0.37
1004	4	200	300	800	8000	6	1.1	800	8000	175	0.53
1005	5	175	250	500	8000	7.5	1.1	500	8000	150	0.71
1006	6	175	200	500	5000	8	1.1	400	5000	150	0.85



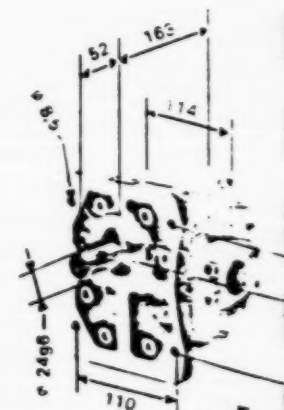
SERIE 2

2004	4	250	300	1000	3500	8	1.8	300	4000	200	0.53
2006	6	250	300	1000	3500	8	1.8	300	4000	200	0.85
2008	8	250	300	1000	3500	12	1.7	300	4000	200	1.14
2012	12	250	300	800	3500	17.3	1.8	250	4000	200	1.75
2015	15	225	250	500	3500	22.5	2.1	250	3500	200	2.22
2018	18	200	225	500	3500	27	2.2	200	3500	175	2.68
2022	22	180	200	500	3500	33	2.3	200	3500	150	3.22
2026	26	150	175	500	3000	39	2.7	200	3000	150	3.85
2030	30	150	175	500	3000	45	2.8	200	3000	150	4.44



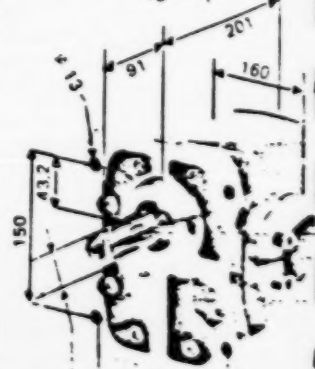
SERIE 3

3020	20	250	300	800	3000	30	5.8	300	3500	200	2.86
3025	25	250	300	800	3000	37.5	5.8	300	3500	200	3.82
3031	31	225	250	500	3000	46.5	5.8	300	3000	200	4.48
3040	40	225	250	500	3000	60	6.7	250	3000	200	6.85
3050	50	225	250	500	3000	75	6.9	250	3000	200	7.32
3060	60	175	225	500	2500	90	7	200	3000	175	8.88
3071	71	150	175	500	2500	106.5	7	200	2500	150	10.83
3080	80	125	150	500	2500	120	7.1	200	2500	125	11.98
3090	80	125	150	500	2000	135	7.8	200	2000	125	13.20
3100	100	125	150	500	2000	150	8	200	2000	125	14.25



SERIE 4

4075	75	200		500	2500	112.5	17	300	2500	200	11
4110	112	200		500	2500	166	17.2	300	2500	200	16.5
4150	150	200		500	2500	225	17.4	250	2500	200	22
4175	175	175		400	2500	262.5	18	250	2500	175	26
				500	2500	312.5	18.4	250	2500	150	32



FLUTEC HOSE BREAK VALVES

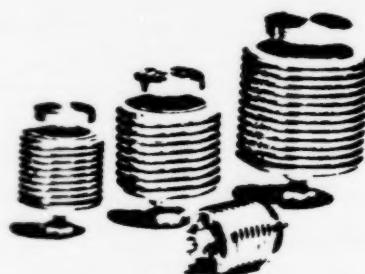
1. DESCRIPTION

FLUTEC Hose Break Valves are used to eliminate uncontrollable movements of the actuator; for example in hose breaks of dead weight cylinders. These are volume-limiting flat seat valves. The valve poppet is normally kept open by a spring, which is designed so that the force of the spring is greater during normal operation than the force on the valve poppet created by the flow.

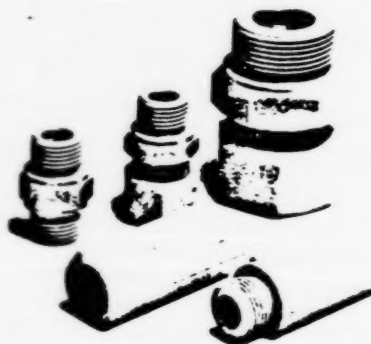
The valve stays open, and the flow can move in either direction. Automatic shut-off occurs if the flow resistance force on the poppet exceeds the level set on the valve. The valve opens automatically by pressurizing connection A. Depending on the pressure P_b , the leakage rate on the cartridge valve threads (RBE ...) amounts to approximate 0-100 cc./min. If the actuator drops slowly, the valve threads can be sealed into the cartridge and made leakfree. The closing flow rate is adjustable at the valve.

Valves are installed between actuator and possible line breakage point:

1. By screwing cartridge unit directly into the connection hole of the cylinders.
2. By installing housing valve directly into the cylinder port connection.



Type RBE ...
Cartridge Unit



Type RB ...
Housing Valve

2. TECHNICAL DATA

2.1. GENERAL

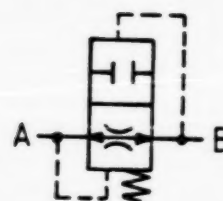
2.1.1. Hydraulic Symbol

Hose Break Valves

B ... Fusing end of valve

A-B ... Free flow

B-A ... Operating direction, valve closes if flow rate exceeds adjustment.



2.1.2. Type Code
(also ordering example)

RB E - 7/16-20 - 0 - 50

Hose Break Valves _____

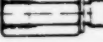
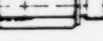
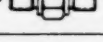
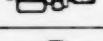
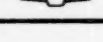
Type of Connection _____
See 2.1.3.

Size of Connection _____
See 2.1.3.

Modification Number _____

Closing Flow _____
See 2.1.3.

2.1.3. Table and Type Code

Type of Connection		Size of Connection			
Code Letter		Connection A	Connection B		
E		Cartridge - SAE		SAE 7/16-20	Cartridge
E		Cartridge - R		R 1/4"	
XB		SAE J 514	SAE J 514	SAE 7/16-20	Housing valve
XB		Bore Hole X Pattern DIN 3852	Bore Plug with seal lip, B Pattern DIN 3852	R 1/4"	
XX		Bore Hole X Pattern, DIN 3852		R 1/4"	
BB		Bore Plug with seal B Pattern, DIN 3852		R 1/2"	
SB		Threaded Cut-ring S series heavy duty DIN 2353	Bore Plug with seal lip, B Pattern DIN 3852	R 1/2"	
CC		Bore plug with U.S. standard thread NPTF		1/2 NPTF	
				3/4 NPTF	
				1 NPTF	
				1 1/4 NPTF	

Closed Flow Rate Q _A	(GPM)	(l/min)	.8-6.6	1.6-13.2	3.2-19.8	6.6-39.6
			3-25	6-50	12-75	25-150
To avoid the activation of hose break valves on flow surges, the closing flow rate should be at least 20% above the normal flow rate.			The valves for standard production are shipped with max. flow rates. Settings are optional. See curves under 2.2.4. If the factory is to set the flow rates, this should be indicated when ordering, (GPM) - (l/min).			

2.1.4. Design

Flat Seat Valve

2.1.5. Mounting Method

RBE ... Cartridge
RB ... Housing Valve for
inline installation

2.1.6. Approximate Weights

RBE

SAE $\frac{7}{16}$ -20
R $\frac{1}{4}$ " .02 lbs - 9 g
SAE $\frac{9}{16}$ -18
R $\frac{3}{8}$ " .04 lbs - 16 g
SAE $\frac{3}{4}$ -16
R $\frac{1}{2}$ " .07 lbs - 31 g
SAE $1\frac{1}{16}$ -12
R $\frac{3}{4}$ " .13 lbs - 57 g

RBXB

SAE $\frac{7}{16}$ -20
R $\frac{1}{4}$ " .17 lbs - 77 g
SAE $\frac{9}{16}$ -18
R $\frac{3}{8}$ " .25 lbs - 110 g
SAE $\frac{3}{4}$ -16
R $\frac{1}{2}$ " .43 lbs - 195 g
SAE $1\frac{1}{16}$ -12
R $\frac{3}{4}$ " .89 lbs - 400 g

RBXX

R $\frac{1}{4}$ " .19 lbs - 83 g
R $\frac{3}{8}$ " .26 lbs - 116 g
R $\frac{1}{2}$ " .47 lbs - 210 g
R $\frac{3}{4}$ " .93 lbs - 420 g

RBBB

R $\frac{1}{2}$ " .24 lbs - 105 g
R $\frac{3}{4}$ " .24 lbs - 180 g
R 1" .72 lbs - 325 g
R $1\frac{1}{4}$ " 1.3 lbs - 595 g

RBSB

R $\frac{1}{2}$ " .21 lbs - 95 g
R $\frac{3}{4}$ " .38 lbs - 170 g
R 1" .68 lbs - 305 g
R $1\frac{1}{4}$ " 1.13 lbs - 510 g

RBCC

$\frac{1}{2}$ NPTF .21 lbs - 97 g
 $\frac{3}{4}$ NPTF .35 lbs - 155 g
1 NPTF .64 lbs - 290 g
 $1\frac{1}{4}$ NPTF 1.12 lbs - 505 g

2.1.7. Mounting Position

Optional

2.1.8. Direction of Flow

A-B ... free Flow
B-A ... free Flow
valve automatically closes
if flow exceeds set level.

2.1.9. Flow Media

Mineral Oil in accordance with
DIN 51525 and DIN 51525.
Consult Factory for other media.

2.2. HYDRAULIC DATA

2.2.1. Operating Pressure

p max. pressure 5000 PSI
= 350 BAR
p min. pressure 145 PSI
= 10 BAR

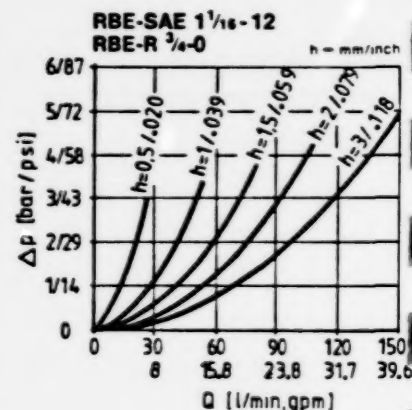
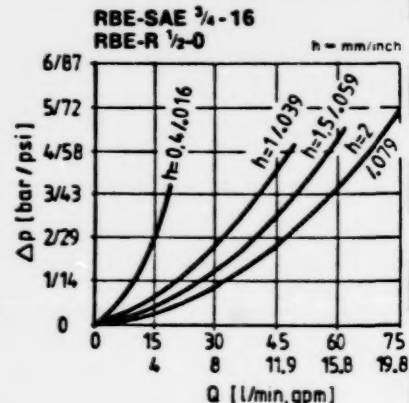
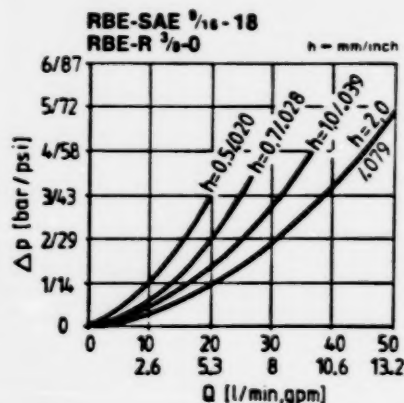
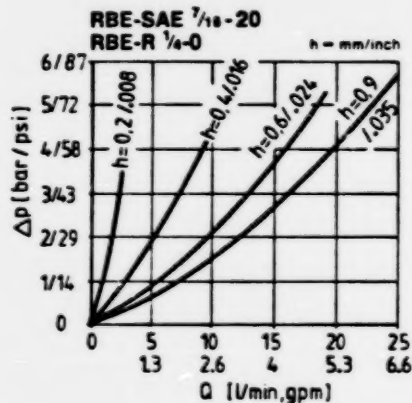
2.2.2. Temperature Range

min ... max ...
+ 4° F ... + 176° F
- 20° C ... + 80° C

2.2.3. Nominal Flow Rate

Pressure differential in Δp
dependent on Flow Q at different
operating levels "h" (mm/inch.)
measured at 168 SSU,
 $t_{oil} = 122^\circ F = 50^\circ C$.

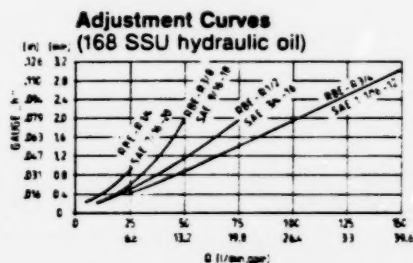
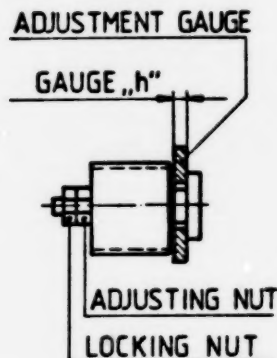
The curves are valid for
cartridges RBE ... and for
housing valves RB ... in
accordance with table 2.1.3. for
both flow directions. The limit
line indicates the maximum
closing flow rates dependent on
"h" for both flow directions.



2.2.4. Adjustment Curves for Closing Flow Rates - Setting

The size of the closing flow rate is dependent on the dimension "h". After loosening the lock nut, set the adjustment with a thickness gauge to the proper setting. The lock nut must be tightened for safety.

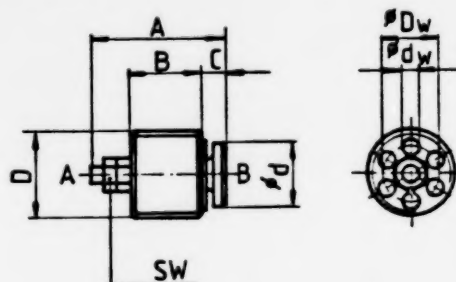
Adjustment Curves
(168 SSU hydraulic oil)



The adjustment curves are valid for cartridge RBE ... and for all housing valves RB ... and cartridge RBE in accordance with table 2.1.3.

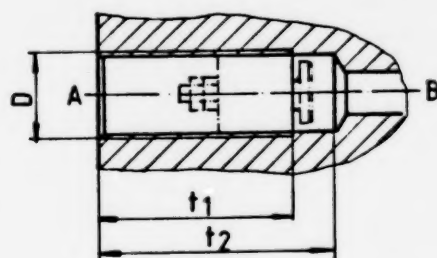
For model RB the cartridge must be removed from the housing for adjustment. See special tool for installation and removal under section 3.

3. DIMENSIONS



Cartridge

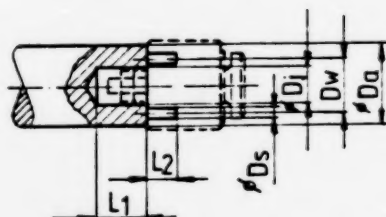
Type		D	A	B	C	ød	SW	øD _w	ød _w
RBE-SAE 7/16-20	inch	7/16-20	.866	.453	.138	.374	5 mm	.315	.098/.197
RBE-R 1/4-0...	mm	R 1/4"	22	11.5	3.5	9.5	5	8	2 5/5
RBE-SAE 9/16-18	inch	9/16-18	1.063	.531	.197	.472	5.5 mm	.394	.138/.236
RBE-R 3/8-0...	mm	R 3/8"	27	13.5	5	12	5.5	10	3 5/6
RBE-SAE 3/4-16	inch	3/4-16	1.299	.669	.217	.551	7/16	.472	.177/.315
RBE-R 1/2-0...	mm	R 1/2"	33	17	5.5	14	7	12	4 5/8
RBE-SAE 1 1/8-12	inch	1 1/8-12	1.614	.925	.256	.709	9/16	.630	.256/.354
RBE-R 3/4-0...	mm	R 3/4"	41	23.5	6.5	18	7	16	6 5/9



Bore for Cartridge

Type		D	t ₁	t ₂
RBE-SAE 7/16-20	inch	7/16-20	1.260	1.496
RBE-R 1/4-0-...	mm	R 1/4"	32	38
RBE-SAE 9/16-18	inch	9/16-18	1.417	1.732
RBE-R 3/8-0-...	mm	R 3/8"	36	44
RBE-SAE 3/4-16	inch	3/4-16	1.732	2.087
RBE-R 1/2-0-...	mm	R 1/2"	44	53
RBE-SAE 1 1/16-12	inch	1 1/16-12	2.008	2.402
RBE-R 3/4-0-...	mm	R 3/4"	51	61

The values given in the tables are minimum values only.



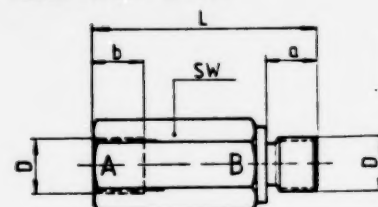
Tools for Installations

Type		Da _{max}	Dw	Di	Ds	L _{1min}	L _{2max}
RBE-R 1/4-0-...	mm	11.5	8	5.8	2	9	5
RBE-R 3/8-0-...	mm	15	10	6.5	3	9	6
RBE-R 1/2-0-...	mm	18	12	8.2	3.5	11	8
RBE-R 3/4-0-...	mm	24	16	8.5	6	12	8

Housing Valves

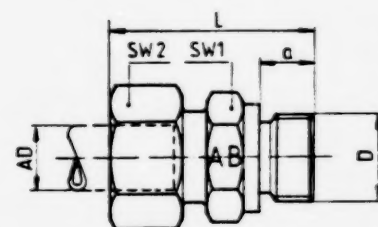
RBXB SAE

RBXB - R ... - 0 - ...



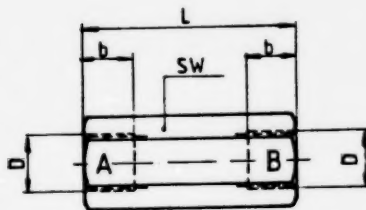
D		L	a	b	SW
7/16-20	inch	2.126	.472	.472	3/4
R 1/4"	mm	54	12	12	19
9/16-18	inch	2.362	.472	.472	7/8
R 3/8"	mm	60	12	12	22
3/4-16	inch	2.835	.551	.551	1 1/16
R 1/2"	mm	72	14	14	27
1 1/16-12	inch	3.228	.630	.630	1 1/8
R 3/4"	mm	82	16	16	36

RBSB - R ... - 0 - ...



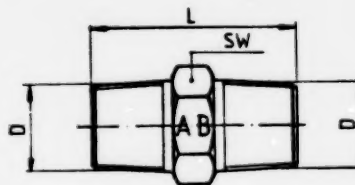
D		L	a	AD	SW	SW ₂
R 1/2"	mm	50	14	16	27	30
R 3/4"	mm	58	16	20	32	36
R 1"	mm	65	18	25	41	46
R 1 1/4"	mm	73	20	30	50	50

RBXX - R ... - 0 - ...



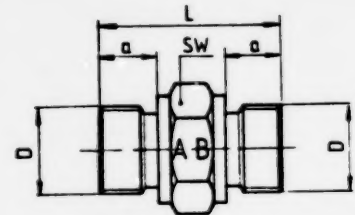
D		L	b	SW
R 1/4"	mm	52	12	19
R 3/8"	mm	60	12	22
R 1/2"	mm	68	14	27
R 3/4"	mm	78	16	36

RBCC - ... NPTF - 0 - ...



D		L	SW
1/2 NPTF	inch	1.968	1
1/2 NPTF	mm	50	24
3/4 NPTF	inch	1.968	1 1/4
3/4 NPTF	mm	50	30
1 NPTF	inch	2.362	1 7/16
1 NPTF	mm	60	36
1 1/4 NPTF	inch	2.441	1 13/16
1 1/4 NPTF	mm	62	46

RBBB - R ... - 0 - ...



D		L	a	SW
R 1/2"	mm	45	14	27
R 3/4"	mm	50	16	32
R 1"	mm	56	18	41
R 1 1/4"	mm	65	20	50

Dimensions are for general information only. Due to constant development and updating of technical details, we ask that all critical dimensions be made by requesting a certified print.

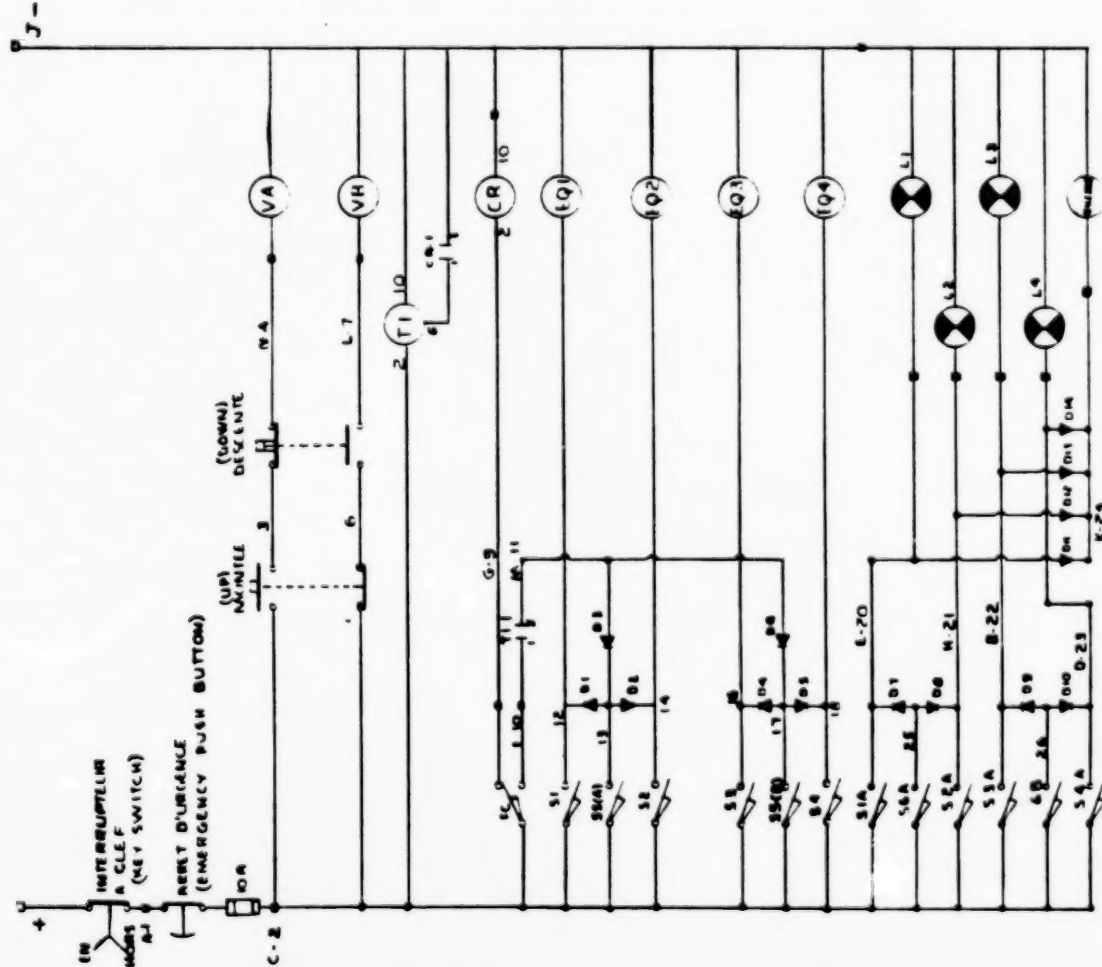
Fluidtechnische Geräte GmbH
Justus-von-Liebig-Straße
D-6603 Sulzbach/Saar
Telefon (06897) 3081 und 3082
Telex 04-429345 flut

Flutec

APPENDIX B

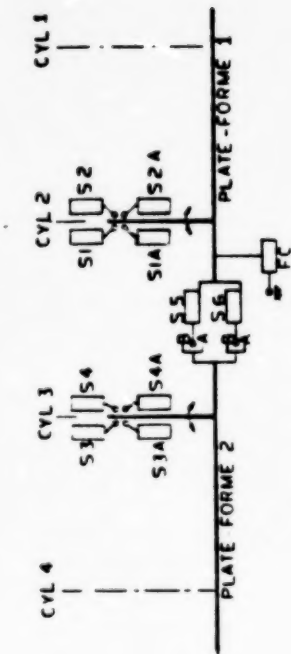
Electrical system

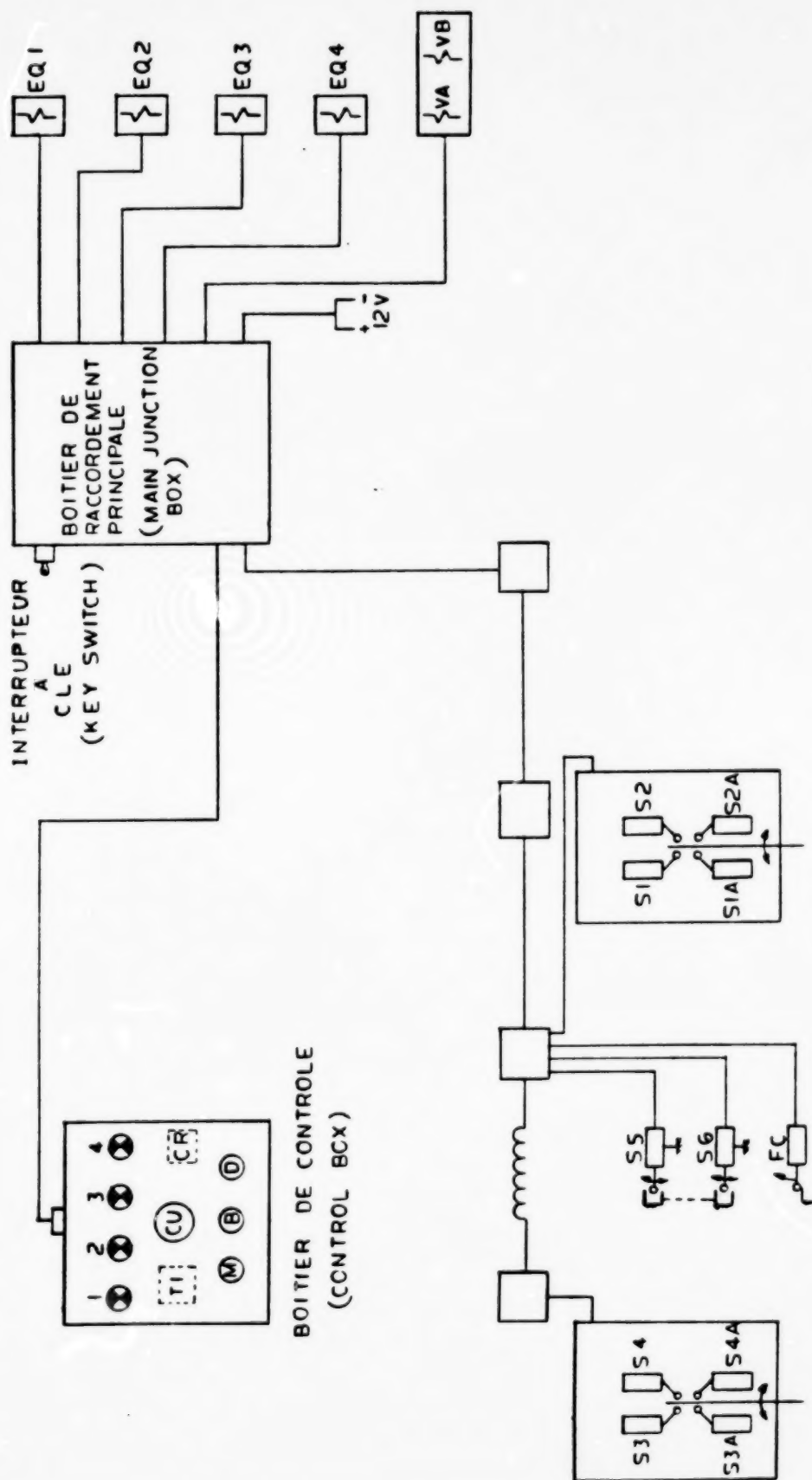
- Schematic diagram
- Schematic wiring
- Parts list
- Technical specifications



SCHEMA DE PRINCIPE DU SYSTEME ELECTRIQUE
(ELECTRICAL SCHEMATIC DIAGRAM)

ITEM	LOCALISATION	DESCRIPTION	QTB
	B'ie de record's	Interrupteur à clé	1
	B'ie de contrôle	Arrêt d'urgence	1
	Control box	Push button	1
		10 A fuse	1
N		Section process "MONTAGE"	
		UP - push button	1
		DOWN - push button	1
VA-VB	Groupe hydraulique	Electronique "MONTAGE-DEGRADATION"	1
VI	B'ie de contrôle	Electronique "UP-DOWN"	1
VE	Control box	Relais temporisé	1
		Section de contrôle	1
FC	Control table	Control relay	1
FI-FV	Centre of table	Interrupteur de fin de course	1
		Limit switch	1
VI-VE	B'ie spec. cyl. 01	Interrupteur de contrôle de vitesse	1
VI-VE	B'ie spec. cyl. 02	Local control switch	1
VI-VE	B'ie spec. cyl. 03	Local control switch	1
VI-VE	B'ie spec. cyl. 04	Local control switch	1
VI-VE	Centre de table	Interrupteur de vitesse - des pistons	1
VI-VE	Centre de table	Interrupteur de vitesse - des pistons	1
VI-VE	B'ie spec. cyl. 01	Local limit control switch	1
VI-VE	B'ie spec. cyl. 02	Local limit control switch	1
VI-VE	B'ie spec. cyl. 03	Local limit control switch	1
VI-VE	B'ie spec. cyl. 04	Local limit control switch	1
VI-VE	Groupe hydraulique	Electronique d'égulation	1
VI-VE	Relais	Relais de contrôle	1
VI-VE	Control box	Relais de contrôle	1
VI-VE	B'ie record's	Relais de contrôle	1
VI-VE	Justification box	Blade	10
VI-VE	B'ie de contrôle	Blade	1
VI-VE	Control box	Blade	1





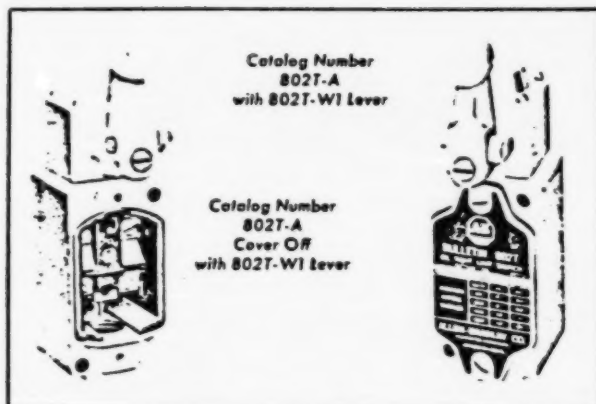
SCHEMA DE CABLAGE
(WIRING DIAGRAM)

LISTE DE PIECES					REVISION	
ITEM	DESCRIPTION	SYMBOLE	FABRICANT	N° DE PIÈCE	QUA	
	Fiche multi-contacts		Amphenol	97-3102A-20-27P		
	Prise multi-contacts		Amphenol	97-3106A-20-27S		
	Interrupteur	53 54 55 56	A-B	802T-H		9
	Interrupteur	55 56	A-B	802T-NP		2
	Levier micrométrique		A-B	802T-W6		11
	Bouton poussoir momentané VERT	Descente	A-B	800T-A1A		1
	Bouton poussoir momentané ROUGE	Montée	A-B	800T-B6A		1
	Plaque signalétique MONTE		A-B	800T-X559		1
	Plaque signalétique DESCENTE		A-B	800T-X559		1
	Lampes indicatrices	L1 L2 L3 L4	A-B	800T-Q12R		4
	Amplificateur 12V		CE	755		4
	Plaque signalétique CYLINDRE #1		A-B	800T-X559		1
	Plaque signalétique CYLINDRE #2		A-B	800T-X559		1
	Plaque signalétique CYLINDRE #3		A-B	800T-X559		1
	Plaque signalétique CYLINDRE #4		A-B	800T-X559		1
	Plaque signalétique ARRÊT D'URGENCE		A-B	800T-X559		1
	Relais temporisé (delay on release) 12VCC	T1	P & B	CMD-38-26000		1
	Embase de relais		P & B	27E-123		2
	Relais 12 VCC 3PDT	CR	P & B	KAP-14DG		1
	Bouton poussoir maintenu	Arrêt d'urgence	A-B	800T-FX604		1

TITRE			PROJET N°		EDITION	
LISTE DE MATERIEL ELECTRIQUE			DESSIN N°		368-00-02	
PRÉPARÉ	VÉRIFIÉ	APPROUVÉ	FEUILLE 1			

LISTE DE PIECES					REVISION
ITEM	DESCRIPTION	SYMBOLE	FABRICANT	N° DE PIÈCE	QUA
	Boîtier de contrôle		Hammond	1488-1819	1
	Boîte étanche n° 4, 16" x 14" x 6"	Boîtier de rac't principal	Hammond	1414-N4PH06	1
	Boîte étanche n° 4, 8" x 12" x 4"		Hammond	1414-N4PH1	4
	Tuyaux rigides aluminium				30 m
	Condulet aluminium LL 1"		Crouse Hinds	LL39C	3
	Condulet aluminium LR 1"		C/H	LR39C	3
	"Bullet" 1" aluminium		Thomas & Betts	372AL	8
	Connecteur "strain relief" (#16-7)		T & B	2544	8
	Connecteur "strain relief" (16-14)		T & B	2546	2
	Connecteur "strain relief" (16/6)		T & B	2545	2
	Fils TEM #16-29STR NOIR				300 m
	Fils TEM #16-29STR ROUGE				380 m
	Fils TEM #16-29STR BRUN				600 m
	Fils TEM #16-29STR JAUNE				600 m
	Fils TEM #14 VERT				150 m
	Cordon flexible type SO #16/7 fils		O.D. 550		25 m
	Cordon flexible type SO #16/14 fils		O.D. 760		10 m
	Cordon rétractable type SO #16-6		O.D.		1
	1.2 M rétracté 6/1 en extension				
	INTERRUPTEUR A CLE		A-8	800T-FX604	
CENTRE DE RECHERCHE INDUSTRIELLE DU QUEBEC			PROJET N°	4-0076	EDITION
TABLE DE RENVERSEMENT : LISTE DE MATERIEL ELECTRIQUE					
PREPARE	JACQUES AURIN	03 09 85	VERIFIE	DESSIN N°	368-00-02
			APPROUVE		FEUILLE 2

OILTIGHT LIMIT SWITCHES



DESCRIPTION—The Bulletin 802T line is a wide, diversified selection of oiltight limit switches designed for the remote control of automatic starters and contactors, both AC and DC. Bulletin 802T's are ideal for any limit switch application in which heavy duty pilot ratings, small size, a high degree of versatility and a rugged, oiltight construction are desirable. An important factor in the automation of industry, these limit switches are being applied extensively on conveyor systems, transfer machines, automatic turret lathes, milling and boring machines, radial drills, and many other types of modern, high speed production equipment.

HIGH DEGREE OF VERSATILITY—Each Bulletin 802T can be adapted, easily and inexpensively, for many different kinds of installations. Switch enclosures can be mounted in any position; operating heads can be rotated and fastened in any one of four positions 90° apart; operating levers are interchangeable, and can be rotated and clamped in any position through 360°; and accessories can be added to switches already in the field.

OILTIGHT CONSTRUCTION—Synthetic rubber seals protect the operating parts against entry of oil, dust, abrasives and coolant.

RUGGED, DEPENDABLE CONTACT BLOCK—The contacts used in Bulletin 802T switches are snap action type with high snap-through force resulting in minimum contact rebound. Double break, fine silver contacts are electrically independent, but cannot be used on opposite polarities.

EASY MOUNTING AND WIRING—Each switch base has four mounting holes: two "through" holes for front mounting, and two tapped holes in the back for rear mounting. Removing the cover and cover gasket exposes the pressure plate type terminals on the contact block. These face to the front of the switch and have ample wiring space. The standard conduit opening is a 1/2" threaded tap in the bottom.

LEVER TYPE SWITCHES—These switches are operated by means of a lever which is clamped to a knurled shaft extending

from the operating head. Moving the lever clockwise or counter-clockwise from the normal position operates the contacts.

Lever type switches can be equipped with any one of seven different operating levers: roller lever, adjustable roller lever, micrometer adjustment roller lever, rod lever, one-way rod or roller lever and fork lever. These can be used interchangeably on all lever type switches except the low operating force switch, which requires the lever identified by catalog number 802T-W5.

The micrometer adjustment roller lever, catalog number 802T-W6, is designed especially for installations where the exact position of the roller is a critical factor. This lever has a pivoted roller which can be turned laterally. After clamping the lever to the switch shaft, the position of the roller can be precisely adjusted through an arc of 7 1/2° on either side of the center or straight-line position.

PUSH TYPE SWITCHES—These switches are actuated by means of a rod or plunger located on the top or side of the operating head. Pushing the plunger into the head causes the contacts to operate. Two kinds of plunger are available: button type and steel roller. Push type switches can be supplied in spring return and maintained contact constructions. All use the standard contact block.

WOBBLE STICK AND CAT WHISKER TYPE SWITCHES—Both switches are actuated by a rod or stick extending from the top of the operating head. Moving the rod in any direction causes the contacts to operate. All wobble stick and cat whisker switches have the standard contact block, and are supplied in the spring return construction only.

DUAL SWITCHES—The dual switch is actually two limit switches—two actuator-contact block combinations—which function independently but have a common enclosure. For installations where two switches would be mounted side by side. There is a saving on installation time and fittings.

PLUG-IN SWITCHES—The plug-in limit switch line can reduce costly downtime when switch replacement is often required. The same base is common to the entire line, any type of actuator and contact block combination can be plugged in and fastened in minutes.

TWO POLE SWITCHES—Two pole switches contain two standard, single pole contact blocks, providing a total of two NO and two NC contacts. The blocks are mounted one on top of the other in the vertical limit switch construction, or along side of each other in the horizontal construction. Switch plungers are mechanically coupled in both constructions. When actuated, contacts in the two blocks are operated.

CONTACT RATINGS—A600

A.C. Control Circuit	↔↔↔	↔↔↔	D.C. Control Circuit	Contact Rating
120-600 V	720 VA	7200 VA	115-125 V	0.4 A
6-72 V	10 Amp.	60 Amp.	230-250 V	0.2 A
			550-600 V	0.1 A

OILTIGHT LIMIT SWITCHES

BULLETIN

802T

LEVER TYPE



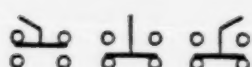
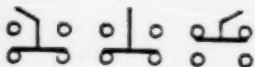
SINGLE POLE, DOUBLE THROW							DOUBLE POLE, DOUBLE THROW						
Shaft Movement and Contact Action	Operating Torque	Travel to Operate Contact (Max.)	Max. Travel	Travel to Reset Contact (Max.)	Catalog Number	Price	Shaft Movement and Contact Action	Operating Torque	Travel to Operate Contact (Max.)	Max. Travel	Travel to Reset Contact (Max.)	Catalog Number	Price
Clockwise or Counter-Clockwise 	3 In.-Lbs.	16.5°	43°	8°	802T-A	\$29	Clockwise or Counter-Clockwise 	3 In.-Lbs.	18°	42°	14°	802T-AT	\$72
	4.5 In.-Lbs.	6°	53°	3°	802T-H	31		6 In.-Lbs.	9°	53°	6°	802T-HT	74
Clockwise 	3.5 In.-Lbs.	16.5°	43°	8°	802T-A1	29	Clockwise 	3.5 In.-Lbs.	18°	42°	14°	802T-A1T	72
	1.5 In.-Lbs.	15°	53°	8°	802T-A3	29		6 In.-Lbs.	9°	53°	6°	802T-H1T	74
Counter-Clockwise 	4.5 In.-Lbs.	6°	50°	3°	802T-H1	31	Counter-Clockwise 	3.5 In.-Lbs.	18°	42°	14°	802T-A2T	72
	3.5 In.-Lbs.	16.5°	43°	8°	802T-A2	29		6 In.-Lbs.	9°	53°	6°	802T-H2T	74
Clockwise Shaft cannot move counter-clockwise 	4 In.-Lbs.	20°	91°	11°	802T-L1	31	Clockwise Shaft cannot move counter-clockwise 	4 In.-Lbs.	28°	91°	18°	802T-L1T	74
	4 In.-Lbs.	20°	91°	11°	802T-L2	31		4 In.-Lbs.	28°	91°	18°	802T-L2T	74
NEUTRAL POSITION • SPRING RETURN							MAINTAINED-CONTACT LEVER MOVEMENT						
Normally Open Contacts 	2.25 In.-Lbs.	12°	53°	6°	802T-NP	41		3 In.-Lbs.	75°	84°	50°	802T-AMT	78

■ Catalog Numbers 802T-A3 and 802T-A4—As listed in the table, Catalog Numbers 802T-A3 and 802T-A4 are uniquely different from the standard lever-type spring-return switches; they feature greater damping on the return stroke and a provision for field change in direction of operation, (clockwise to counter-clockwise or vice-versa)

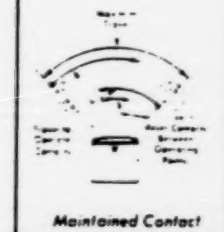
NOTE: A reduction in damping will occur when modified for high temperature application

802T-A3

802T-A4



Modifications and Accessories—Refer to Page 121. Levers—Refer to Page 118.



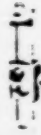
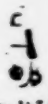
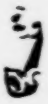
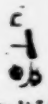
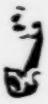
ALLEN-BRADLEY CANADA

DISCOUNT SCHEDULE A 117

OILTIGHT LIMIT SWITCHES

The levers shown in the table below are to be used with Bulletin 802T, 802R and 802X limit switches.

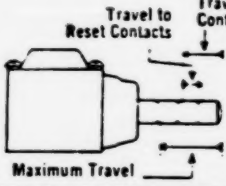
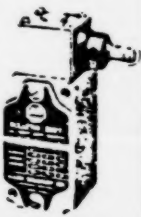
OPERATING LEVERS

ROLLER LEVER						ROD LEVER				
Type	Material	Diameter	Width	Catalog No	Price	Type	Material	Diameter	Catalog No	Price
 Non Adjustable 1" Radius except 802T-W9 which is 1/2"	Nylon	1/4"	9/32"	802T-W1	\$3		Stainless Steel Rod 5" Radius	1/4"	802T-W3	\$5
	Nylon	1/4"	1"	802T-W1H	5		Stainless Steel Rod 8 1/2" Radius	1/4"	802T-W3B	6
	Steel	1/4"	1/4"	802T-W1A	3		Stainless Steel Rod 11 1/2" Radius	5/64"	802T-W3A	5
	Ball Bearing	1/4"	15/64"	802T-W1B	7		Nylon Rod 12" Radius	1/4"	802T-W3C	7
	Beryllium Copper (Non-Sparking)	1/4"	9/32"	802T-W1J	8		Stainless Steel Rod 5" Radius	1/16"	802T-W5	5
 Non Adjustable Roller on Back 1" Radius	Nylon	1/4"	9/32"	802T-W9	4		Stainless Steel Rod 5" Radius	1/16"	802T-W8	10
	Nylon	1/4"	9/32"	802T-W1E	3		Nylatron 6" Radius 2" width of loop	3/16"	802T-W14	7
	Nylon	1/4"	1"	802T-W1D	5					
	Nylon	1 1/2"	9/32"	802T-W1G	3	 Fork Lever 1 1/2" Radius				
	Steel	1/4"	1/4"	802T-W1F	3					
 Adjustable 1 1/2" - 3" Radius	Steel	1/4"	1/4"	802T-W1C	5					
	Nylon	1/4"	9/32"	802T-W2	5					
	Nylon	1/4"	1"	802T-W2D	9					
 Micrometer Adjustment	Nylon	1 1/2"	9/32"	802T-W2A	7					
	Steel	1/4"	1/4"	802T-W2B	5					
	Ball Bearing	1/4"	15/64"	802T-W2C	7					
 One-Way 1 1/2" Radius	Nylon	1/4"	9/32"	802T-W4	5					
	Steel	1/4"	1/4"	802T-W4B	5					
	Nylon	1/4"	9/32"	802T-W4A	5					
	Nylon	1/4"	1"	802T-W4F	9					
	Steel	1/4"	1/4"	802T-W4C	5					
 Non Adjustable Offset 1 1/2" Radius	Nylon	1/4"	9/32"	802T-W6	8.50	1 Do not use on maintained-contact limit switches. 2 When mounted on plug-in devices, the offset lever provides equivalent cam tracking to the non plug-in devices using Catalog No. 802T-W1 levers. 3 Recommended for use with low-operating force switches.				
	Steel	1/4"	1/4"	802T-W6A	8.50					
	Ball Bearing	1/4"	15/64"	802T-W6B	15.50					
 One-Way 1 1/2" Radius	Nylon	1/4"	9/32"	802T-W7	16					
	Steel	1/4"	1/4"	802T-W7A	16					
	Ball Bearing	1/4"	15/64"	802T-W7B	20					
 Non Adjustable Offset 1 1/2" Radius	Nylon	1/4"	9/32"	802T-W12	3					
	Steel	1/4"	9/32"	802T-W12A	3					

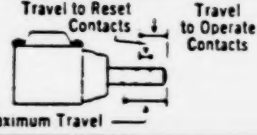
OILTIGHT LIMIT SWITCHES

BULLETIN
802T

PUSH TYPE • SPRING RETURN AND MAINTAINED CONTACT SINGLE POLE, DOUBLE THROW

			SPRING RETURN				MAINTAINED CONTACT
							
Top Push Type	Normal	Operated	TOP PUSH ROD	SIDE PUSH ROD	TOP PUSH ROLLER	SIDE PUSH ROLLER	SIDE PUSH ROD
Side Push Type							
Side Push Type							
Catalog Number			802T-B	802T-C	802T-D	802T-K Roller Vertical 802T-K1 Roller Horizontal	802T-CM
Price			\$32	\$34	\$34	\$38	\$40
Operating Force			3.5 Lbs.	4.5 Lbs.	3.5 Lbs.	4.5 Lbs.	8 Lbs.
Travel to Operate Contact (Max.)			.075"	.125"	.075"	.125"	.234"
Maximum Travel			.202"	.218"	.202"	.218"	.296"
Travel to Reset Contact (Max.)			.030"	.057"	.030"	.057"	.202"

2 POLE CONSTRUCTION DOUBLE POLE, DOUBLE THROW

			SPRING RETURN				MAINTAINED CONTACT
							
Top Push Type	Normal	Operated	TOP ROD	SIDE ROD	TOP ROLLER	SIDE ROLLER	SIDE ROD
Side Push Type							
Side Push Type							
Catalog Number			802T-BT	802T-CT	802T-DT	802T-KT Roller Vertical 802T-K1T Roller Horizontal	802T-CMT
Price			\$75	\$77	\$77	\$81	\$83
Operating Force			5.5 Lbs.	6.5 Lbs.	5.5 Lbs.	6.5 Lbs.	14 Lbs.
Travel to Operate Contact (Max.)			.140"	.140"	.140"	.140"	.234"
Maximum Travel			.234"	.234"	.234"	.234"	.265"
Travel to Reset Contact (Max.)			.062"	.094"	.062"	.094"	.202"

Specifications and Accessories—Refer to Page 121.

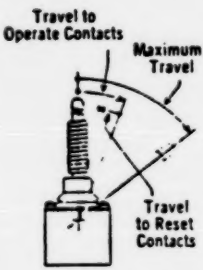
ALLEN-BRADLEY CANADA

DISCOUNT SCHEDULE A 119

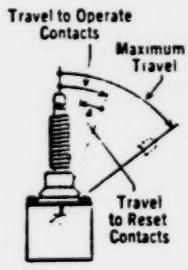
OILTIGHT LIMIT SWITCHES

WOBBLE STICK • CAT WHISKER SINGLE POLE, DOUBLE THROW

NOTE—These switches should be mounted in such a way that the wobble stick or cat whisker will not be deflected beyond the "Maximum Travel" position. This is to prevent excessive backlash, which could cause undesirable repetition of contact action.

 Travel to Operate Contacts Maximum Travel Travel to Reset Contacts Travels are measured at rigid section of stick or whisker.	 Wobble Stick Nylon Extension	 Wobble Stick Wire Extension	 Cat Whisker
Catalog Number	802T-WS	802T-WS1	802T-CW
Price	\$32	\$32	\$32
Operating Torque	4.5 In.-Lbs.	4.5 In.-Lbs.	8 In.-Oz.
Travel to Operate Contact (Max.)	9°	9°	21°
Maximum Travel	10°	10°	22°
Travel to Reset Contact (Max.)	4°	4°	14°

WOBBLE STICK DOUBLE POLE, DOUBLE THROW

 Travel to Operate Contacts Maximum Travel Travel to Reset Contacts Travels are measured at rigid section of stick.	 Nylon	 Wire
Catalog Number	802T-WST	802T-WS1T
Price	\$75	\$75
Operating Torque	7 In.-Lbs.	
Travel to Operate Contact (Max.)	12°	
Maximum Travel	12°	
Travel to Reset Contact (Max.)	9°	

Operating travels and torque are measured at the rigid section of stick or whisker.

LEVER OPERATED • TIME DELAY



DESCRIPTION—The Bulletin 802T time delay oiltight limit switch incorporates a pneumatic timer to produce a time delay before energizing or de-energizing a control circuit. Two general types of limit switches are available. One type delays the contact operation until after the lever has been moved from the normal to the operated position;

the other type provides the delay in contact operation after the lever has moved from the operated to the normal position. The delay period is adjustable from 1/2 second to 15 seconds $\pm$ 25%.

The time delay limit switch is completely oil-tight, and offers most of the features of the standard Bulletin 802T limit switches.

An application example is a counter-boring operation in which the downward feed must be stopped before the bore stops turning. An "On-Delay" Type 802T-R3TD limit switch would allow the bore to dwell for a preset period after the feed drive has been stopped by a limit switch.

NOTE—When using "On-Delay" switches, lever travel must be faster than time setting.

CONTACT RATINGS—Contacts are rated for pilot duty only at 3 amperes, 120 volts maximum.

Lever Operation	Contact Position		Catalog Number		Price
	Normal	Operated	On-Delay Time delay occurs after lever is moved to operated position	Off-Delay Time delay occurs after lever has moved from operated to normal position	
Clockwise Lever can't move counter- clockwise			802T-R1TD	802T-R7TD	\$52
			802T-R3TD	802T-R5TD	
Counter- clockwise Lever can't move clockwise			802T-R2TD	802T-R8TD	
			802T-R4TD	802T-R6TD	
Operating Torque			2 In.-Lbs.		
Pre-travel			45°		
Overtravel			45°		
Maximum Travel			Approx. 90°		
*Required for Timing Accuracy					

Levers—Refer to Page 118

OILTIGHT LIMIT SWITCHES

BULLETIN

802

LOW OPERATING FORCE

These low operating force limit switches can only be supplied with the catalog number 802T-W5 rod lever. The rod can easily be formed to meet special application requirements.

SPRING RETURN—In this limit switch the contacts are restored to their normal position when pressure on the rod is released.

	Operating Torque	12.5 In.-Oz.	Switch With W5 Rod Lever	
	Travel to Close Contact (Max.)	22°	Catalog Number	Price
	Maximum Travel	43°		
	Travel to Reset Contact (Max.)	12°		
	Clockwise or Counter-Clockwise		802T-ALW5	\$40
	Clockwise Lever cannot move counter-clockwise		802T-AL1W5	40
	Counter-Clockwise Lever cannot move clockwise		802T-AL2W5	40

AIR-OPERATED



Bulletin 802T air-operated oil-tight limit switches will operate when 20 P.S.I. $\pm$ 25% of air pressure is applied, and will reset with a pressure drop of from 5 to 10 pounds. A small rod protrudes from the top of the die casting. With the switch not operated, rod extends beyond the surface. With the switch operated, the rod is flush with the surface. The switch can be manually operated by pushing down on the indicator rod. Maximum continuous pressure is 100 P.S.I.

Catalog No.	Price
802T-P	\$52

MODIFICATIONS and ACCESSORIES



MANIFOLD MOUNTING

Modifications and accessories do not apply to the plug-in, the low-operating force, the air-operated, the time-delay or the two-pole type of limit switches.

MANIFOLD MOUNTING—Bulletin 802T switches can be supplied with a special base which permits mounting the switch manifold style on a machine base, panel or raceway. This base is equipped with a wiring hole and synthetic rubber gasket on the back (see illustration).

To order a switch with a manifold mounting base, add the letter "U" to the catalog number, and add \$4 to the list price. Example: Catalog number 802T-AMW4A, list price \$40, becomes catalog number 802T-AMUW4A (shown) at a list price of \$44.

TRANSPARENT COVER—Switches can be furnished with a gasketed, transparent plastic cover. This modification enables the electrician to inspect terminal wiring without removing the switch cover.

To order a switch with a transparent cover, add the letter "Z" to the catalog number of the standard switch, and add \$3 to the list price. For example, catalog number 802T-D, list price \$34, becomes catalog number 802T-DZ list price \$37.

SPECIAL OILTIGHT BUSHINGS—This bushing, a "Tru-Seal" nut with threaded teflon insert, is a valuable accessory for any Bulletin 802T which is connected by means of conduit. 1/2" Bushing—Cat. No. 802T-X4 \$1.50

HIGH TEMPERATURE OPERATION—Bulletin 802T limit switches are designed to operate in a temperature range of -18°C to +54°C (0° to +130°F.) Special limit switches modified for high temperature operation -29°C to +121°C (-20° to +250°F) are available.

NOTE: Minimum temperature is based on the absence of freezing moisture or water.

To order a Bulletin 802T modified for high temperature operation, insert the letter "E" after the operating head designation and add \$8 to the list price. Example: Catalog number 802T-AW1, list price \$32, becomes catalog number 802T-AEW1, list price \$40. (Catalog numbers 802T-W5, W51, CW and the Time Delay limit switches are not available for high temperature operation. Catalog numbers 802T-A3 and A4 are available for high temperature operation except with a reduction in damping).

NEON INDICATING LIGHTS—Bulletin 802T Standard Surface Mounted Limit Switches can be supplied with neon indicating lights—AC 208 240V, 50-60 Hz. and 120V, 50-60 Hz.

To order a limit switch with indicating lights, add the letter "N" for 120V or "N5" for 240V before the lever designation and add \$13 list to the standard switch price; Example: Catalog Number and price of a standard 802T-A1W3 with indicating lights would be 802T-A1NW3 at \$49 list.

In addition, indicating light kits are available for field installation.

Construction	VOLTAGE-AC		Price
	120V 50-60 Hz	208 240V 50-60 Hz	
Standard Switch	802T-N1	802T-N4	\$15
Neutral Position Switch	802T-N2	802T-N10	

ALLEN-BRADLEY CANADA

DISCOUNT SCHEDULE A

OILTIGHT LIMIT SWITCHES

PLUG-IN CONSTRUCTION—EEMAC TYPE 4 WATERTIGHT—EEMAC TYPE 13 OILTIGHT

DESCRIPTION—These limit switches can reduce costly down-time when switch replacement is often required. The two circuit base is common to the entire two circuit line—any type of actuator and contact combination can be plugged in and fastened in minutes. This same feature also applies to the four circuit base. All that is required is loosening the two front captive screws, unplugging the switch unit from the base and replacing. Simple.

With the switch unit removed, the terminals are readily available with adequate room for easy wiring. Contact wiring is accomplished with pressure connectors. The contacts of the switch provide high snap-through force for positive switching action. The double break, fine silver contacts are electrically independent but polarity must be observed in wiring. Design of these contacts promotes extended electrical and mechanical life.

The location of the mounting holes on these switches coincides with that of our present non plug-in type limit switches.

The lever type spring-return switches are field convertible to any of three arrangements—clockwise and counter clockwise, clockwise only or counter clockwise only. Instructions are included with each switch.

ORDERING INFORMATION—Order by catalog number. Select desired lever.

TWO CIRCUIT SWITCHES

CONTACT RATINGS—All units except Catalog Numbers 802T-ALP, AL1P, AL2P, ALP1, AL1P1 and AL2P1. A600:

A.C. Control Circuit	↔↔↔	↔↔↔	D.C. Control Circuit	Contact Rating
120-600 V	720 VA	7200 VA	115-125 V	0.4 A
6-72 V	10 Amp	60 Amp	230-250 V	0.2 A
			550-600 V	0.1 A

CONTACT RATING—Catalog Number 802T-ALP, AL1P, AL2P, ALP1, AL1P1 and AL2P1.

B600

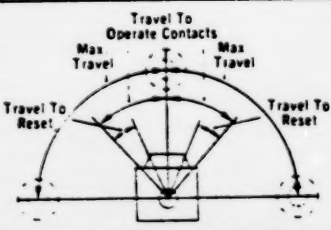
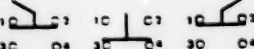
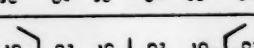
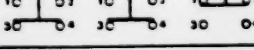
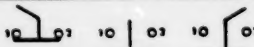
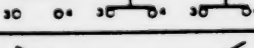
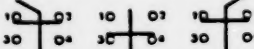
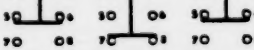
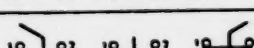
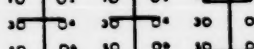
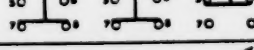
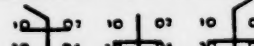
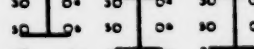
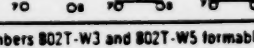
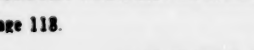
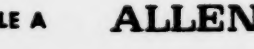
A.C. Control Circuit	↔↔↔	↔↔↔	D.C. Control Circuit	Contact Rating
120-600 V	360 VA	3600 VA	115-125 V	0.4 A
6-72 V	5 Amp	30 Amp	230-250 V	0.2 A
			550-600 V	0.1 A

FOUR CIRCUIT SWITCHES

CONTACT RATINGS—A300

A.C. Control Circuit	↔↔↔	↔↔↔	D.C. Control Circuit	Contact Rating
120-300 V	720 VA	7200 VA	115-125 V	0.4 A
6-72 V	10 Amp	60 Amp	230-250 V	0.2 A

LEVER TYPE • SPRING RETURN

No. of Circuits		-NOTE-								
		LEVER MOVEMENT AND CONTACT OPERATION	Required Operating Torque	Travel to Operate Contact (Max.)	Max. Travel	Travel to Reset Contact (Max.)	Catalog Number	Price	Catalog Number	Price
2 Circuit	Clockwise or Counter- Clockwise		2.6 In.-Lbs.	13°	75°	7°	802T-AP	\$37	802T-AP1	\$28
			15 In.-Ozs.	13°	75°	7°	802T-ALP 1	45	802T-ALP1 1	36
			5 In.-Lbs.	9°	75°	3.5°	802T-HP	40	802T-HP1	31
	Clockwise		2.6 In.-Lbs.	13°	75°	7°	802T-A1P	37	802T-A1P1	28
			15 In.-Ozs.	13°	75°	7°	802T-AL1P 1	45	802T-AL1P1 1	36
			5 In.-Lbs.	9°	75°	3.5°	802T-H1P	40	802T-H1P1	31
	Counter- Clockwise		2.5 In.-Lbs.	13°	75°	7°	802T-A2P	37	802T-A2P1	28
			15 In.-Ozs.	13°	75°	7°	802T-AL2P 1	45	802T-AL2P1 1	36
			5 In.-Lbs.	9°	75°	3.5°	802T-H2P	40	802T-H2P1	31
4 Circuit	Clockwise or Counter- Clockwise		4 In.-Lbs.	13°	75°	7°	802T-ATP	45	802T-ATP1	36
			7 In.-Lbs.	9°	75°	3.5°	802T-HTP	48	802T-HTP1	39
	Clockwise		4 In.-Lbs.	13°	75°	7°	802T-A1TP	45	802T-A1TP1	36
			7 In.-Lbs.	9°	75°	3.5°	802T-H1TP	48	802T-H1TP1	39
	Counter- Clockwise		4 In.-Lbs.	13°	75°	7°	802T-A2TP	45	802T-A2TP1	36
			7 In.-Lbs.	9°	75°	3.5°	802T-H2TP	48	802T-H2TP1	39

1 Use only with Catalog Numbers 802T-W3 and 802T-W5 formable stainless steel operating levers at \$6 list each.

LEVERS—See listing on Page 118.

Modifications and Accessories—Refer to Page 124

OILTIGHT LIMIT SWITCHES

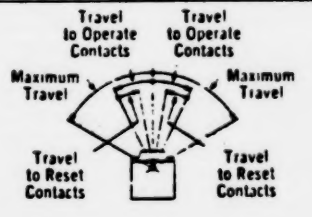
BULLETIN

8021

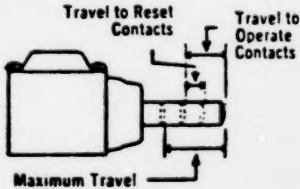
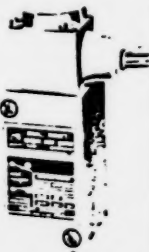
PLUG-IN CONSTRUCTION—EEMAC TYPE 4 WATERTIGHT—EEMAC TYPE 13 OILTIGHT

NEUTRAL POSITION • SPRING RETURN

LEVERS—See listing on Page 118 for levers available for these switches.

LEVER MOVEMENT AND CONTACT OPERATION									
	Operating Torque					Switch Without Lever		Switch Without Lever and Base	
	Clockwise		Counter-Clockwise		Travel to Operate Contact	Max. Travel	Travel to Reset Contact	Catalog Number	Price
	2.5 In.-Lbs.		4.2 In.-Lbs.		13°	75°	7°	802T-NPTP	\$48
								802T-NPTP1	\$39

PUSH TYPE • SPRING RETURN

No. of Circuits																		
			Top Push Rod		Side Push Rod		Top Push Roller		Side Push Roller									
2 Circuit	CONTACT OPERATION		Complete Switch	Switch Without Base	Complete Switch	Switch Without Base	Complete Switch	Switch Without Base	Complete Switch	Switch Without Base								
	Normal	Operated									802T-BP	802T-BP1	802T-CP	802T-CP1	802T-DP	802T-DP1	802T-KP Roller Vertical	802T-KP1 Roller Vertical
																		
	Catalog Number																	
	Price		\$41	\$32	\$44	\$35	\$44	\$35	\$49	\$40								
	Required Operating Force		3.1 Lbs.		3.7 Lbs.		3.1 Lbs.		3.7 Lbs.									
	Travel to Operate Contacts (Max.)		.057 Inch		.114 Inch		.057 Inch		.114 Inch									
	Maximum Travel		.236 Inch		.226 Inch		.236 Inch		.226 Inch									
	Travel to Reset Contacts (Max.)		.028 Inch		.058 Inch		.028 Inch		.058 Inch									
	4 Circuit	CONTACT OPERATION		Complete Switch	Switch Without Base	Complete Switch	Switch Without Base	Complete Switch	Switch Without Base	Complete Switch	Switch Without Base							
Normal		Operated	802T-BTP									802T-BTP1	802T-CTP	802T-CTP1	802T-DTP	802T-DTP1	802T-KTP Roller Vertical	802T-KTP1 Roller Vertical
																		
Catalog Number																		
Price		\$49	\$40	\$51	\$42	\$51	\$42	\$57	\$48									
Operating Force (Max.)		5 Lbs.		5.1 Lbs.		5 Lbs.		5.1 Lbs.										
Travel to Operate Contacts (Max.)		.057 Inch		.114 Inch		.057 Inch		.114 Inch										
Maximum Travel		.236 Inch		.226 Inch		.236 Inch		.226 Inch										
Travel to Reset Contacts (Max.)		.028 Inch		.058 Inch		.028 Inch		.058 Inch										

Modifications and Accessories—Refer to Page 124.

ALLEN-BRADLEY CANADA

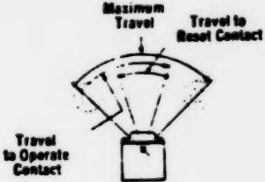
DISCOUNT SCHEDULE A

OILTIGHT LIMIT SWITCHES

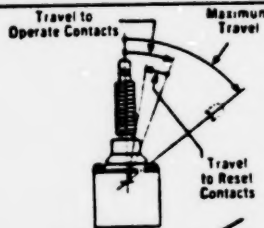
PLUG-IN CONSTRUCTION—EEMAC TYPE 4 WATERTIGHT—EEMAC TYPE 13 OILTIGHT
MAINTAINED-CONTACT LEVER MOVEMENT

LEVERS—See Page 118.

LEVERS—See Page 118.

No. of Circuits										
	Lever Movement Contact Operation		Operating Force	Travel to Operate Contacts (Max.)	Maximum Travel	Travel to Reset Contacts (Max.)	Switch Without Lever		Switch Without Lever and Base	
							Catalog Number	Price	Catalog Number	Price
2 Circuit	 	2.75 In. lbs	61°	88°	28°	802T-AMP	\$45	802T-AMP1	\$36	
4 Circuit	 	2.8 In. lbs	61°	88°	28°	802T-AMTP	\$3	802T-AMTP1	44	

WOBBLE STICK—CAT WHISKER

		WOBBLE STICK		CAT WHISKER
		Nylon Extension	Wire Extension	
 				
Complete Switch	Catalog Number	802T-WSP	802T-WSP1	802T-CWP
	Price	\$41	\$41	\$41
Switch Without Base	Catalog Number	802T-WSP1	802T-WSP1	802T-CWP1
	Price	\$32	\$32	\$32
Operating Torque 		4.5 In. Lbs	4.5 In. Lbs	8.0 In. Oz
Travel to Operate Contacts (Max) 		9°	9°	21°
Maximum Travel 		10°	10°	28°
Travel to Reset Contacts (Max) 		5°	5°	14°

 Operating travels and torques are measured at the rigid section of stick or whisker.

MODIFICATIONS and ACCESSORIES

BASE ASSEMBLY—The limit switch base, including the terminal block is available as a separate unit.

2 Circuit Base Cat. No. 802T-X7 \$9
2 Circuit Manifold
Mount Base Cat. No. 802T-X7U 14
4 Circuit Base Cat. No. 802T-X8 9

VITON SEALS—To order limit switches with viton seals, add the letter "V" to the end of the listed catalog number. Add \$9.50 to the lever type list price and \$12.50 to the push type, wobble stick and cat whisker list price. Not available on manifold mount, and low-operating torque limit switches.

LOW TEMPERATURE OPERATION—Plug-in limit switches are designed to operate in a temperature range of -18° to +110°C, (0° to +230°F) (-18° to +54°C, 0° to +130°F for wobble stick and cat whisker). Special limit switches modified for low temperature operation (-40° to +110°C, -40° to +230°F) are available (minimum temperature based on absence of freezing moisture or water. To order add the letter "E" to catalog number and \$8 to the list price. **Not available** on wobble stick or cat whisker. It's a standard feature on low torque devices.

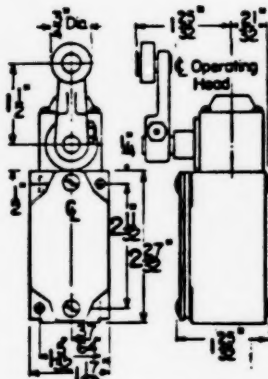
MANIFOLD MOUNT—All series D or E two-circuit plug-in limit switches can be supplied with a special terminal base which permits mounting the switch manifold style on a machine base, panel or raceway. This base is supplied with a wiring hole and gasket on the back. To order a manifold mount switch, add the letter "U" to the listed catalog number and \$4 to the list price.

OILTIGHT LIMIT SWITCHES

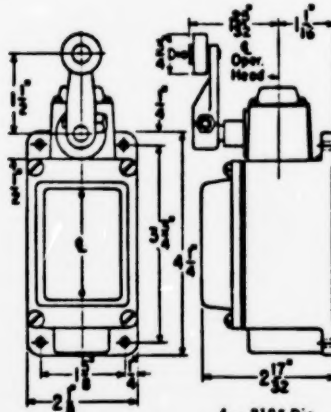
APPROXIMATE DIMENSIONS

BULLE

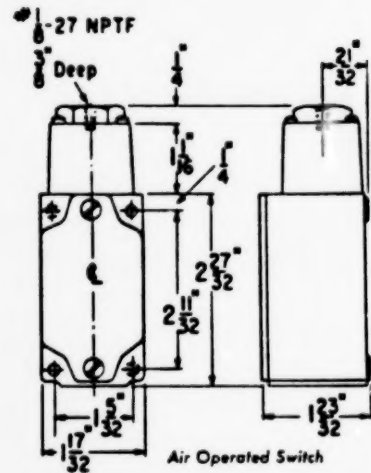
801



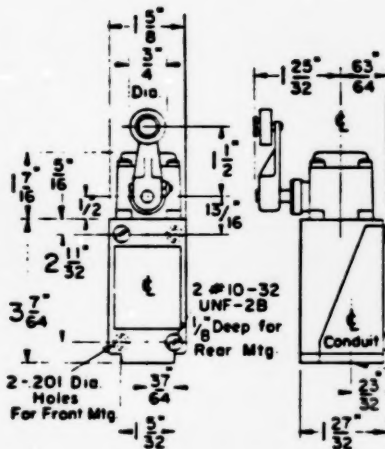
Standard Switch
with 802T-W1 Lever



4—.218" Dia.
Mounting Holes



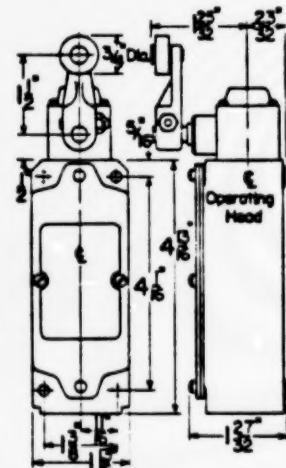
Air Operated Switch



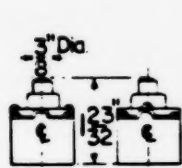
MOUNTING HOLE DIMENSIONS

(Unless otherwise indicated)

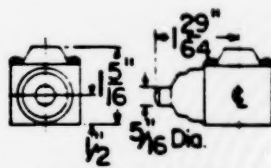
2—.203" Dia. holes for front mounting
2—10-32 Tapped holes 3/8" deep for rear mounting
Conduit—1/2" pipe top



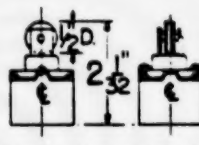
2 Pole Switch with
802T-W1 Lever



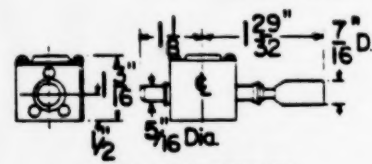
Catalog Number 802T-B
Top Push Rod Head



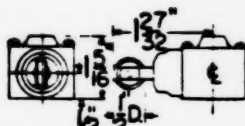
Catalog Number 802T-C
Side Push Rod Head



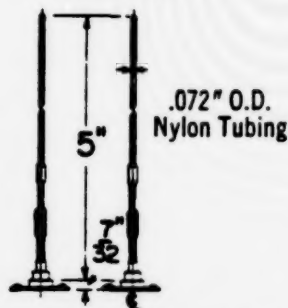
Catalog Number 802T-D
Top Push Roller Head



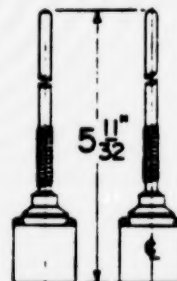
Catalog Number 802T-CM
Maintained Side Push Rod Head



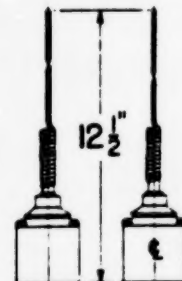
Catalog Number 802T-K
Vertical Side Push Roller Head



Catalog Number 802T-CW
Cat Whisker Head



Catalog Number 802T-W5
Nylon Wobble Stick Head



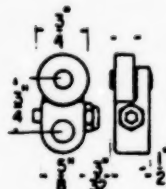
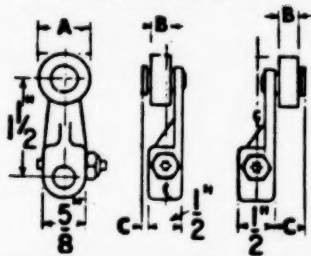
Catalog Number 802T-W51
Wire Wobble Stick Head

ALLEN-BRADLEY CANADA

OILTIGHT LIMIT SWITCHES

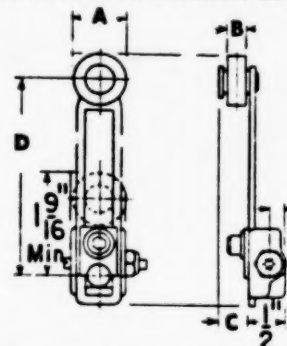
APPROXIMATE DIMENSIONS

ROLLER LEVER



Catalog Number 802T-W9

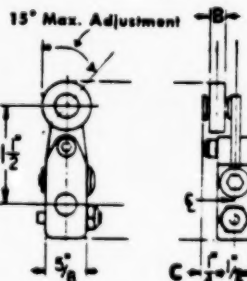
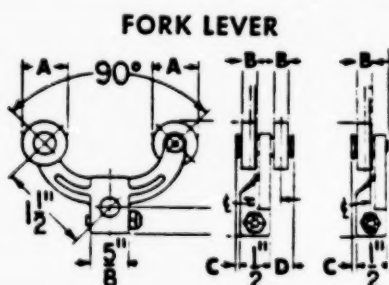
ADJUSTABLE ROLLER LEVER



Catalog No.	Dimensions in Inches				Roller Mounting
	A	B	C		
802T-W1	3/4	9/32	3/32		Front
W1A	3/4	3/4	3/32		Front
W1B	3/4	15/64	1/32		Front
W1C	3/4	3/4	3/4		Back
W1D	3/4	1	1		Back
W1E	3/4	9/32	23/64		Back
W1F	3/4	3/4	3/4		Back
W1G	1 1/2	9/32	23/64		Back
W1H	3/4	1	23/32		Front
W1J	3/4	9/32	1/32		Front

Catalog No.	Dimensions in Inches				
	A	B	C	D	
				Min.	Max.
802T-W2	3/4	9/32	3/4	1 1/16	3
W2A	1 1/2	9/32	3/4	1 1/16	3
W2B	3/4	3/4	3/4	1 1/16	3
W2C	3/4	15/64	11/32	1 1/16	3
W2D	3/4	1	1 1/32	1 1/16	3

ROLLER LEVER, MICROMETER ADJUSTMENT

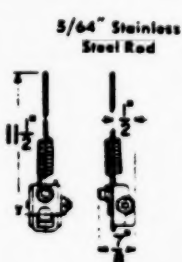
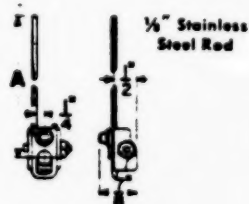


Catalog No.	Dimensions in Inches		
	A	B	C
802T-W5	3/4	9/32	3/4
W6A	3/4	1/4	3/4
W6B	3/4	15/64	3/16

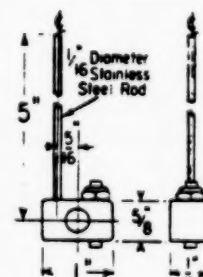
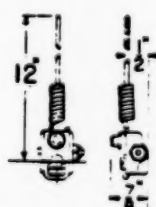
Catalog No.	Dimensions in Inches				Roller Mounting
	A	B	C	D	
802T-W4	3/4	9/32	3/32	1 1/32	Left-Front Right-Back
W4A	3/4	9/32	3/32	—	Both Front
W4B	3/4	3/4	3/32	1 1/32	Left-Front Right-Back
W4C	3/4	3/4	3/32	—	Both Front
W4F	3/4	1	23/32	—	Both Front

ROLLER LEVER, ONE-WAY OPERATION

Catalog No.	Dimensions in Inches	
	A	B
802T-W7	3/4	9/32
W7A	3/4	3/4
W7B	3/4	15/64



Rod Levers



Catalog No.	A
802T-W3	5"
W3B	8 1/2"

Catalog Number 802T-W3A

Catalog Number 802T-W3C

Catalog Number 802T-W5

Catalog Number 802T-W8
One-Way Rod Lever

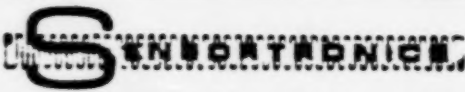
Refer to Page 118 for Prices.

ALLEN-BRADLEY CANADA

APPENDIX C

Weighing pads

- Drawing of a load cell
- Technical specifications of load cells
- Localization of each load cell
- Load cells calibration factors
- Load cells electrical connexions
- Servo accelerometer technical specifications

PREPARED BY	 838 EAST EDNA PLACE • COVINA, CA 91723	TS
E. Farr		65058-10K/200K
APPROVALS		PAGE 1 OF 1 REV LTR

TECHNICAL SPECIFICATION

1.0 GENERAL DESCRIPTION:

1.1 Customer Standard Product

1.2 Customer Part Number _____

1.3 Dim. Outline Dwg 65058-10K/200K

2.0 PERFORMANCE SPECIFICATION:

2.1 Rated Capacity 10K/200K Pounds

2.2 Rated Overload 150

2.3 Rated Excitation 15 VDC Volts

2.4 Bridge Resistance

Output 700 ± 7 Ohms Input 700 ± 7 Ohms

2.5 Full Scale Output 3.0 mV/V Tolerance ± 0.25 %FS

2.6 Zero Balance + 1 %FS

2.7 Creep Less than .02% in 20 min.

2.8 Corner Load N/A

Tolerance N/A

Platform Size N/A

Load N/A

2.9 Linearity .03 % Reading

2.10 Hysteresis .02 %FS

2.11 Insulation Resistance 1000 Megohms @ 50 VDC

2.12 Compensated Temperature Range 0-150 °F

2.13 Thermal Zero Shift .0015 % FS/°F

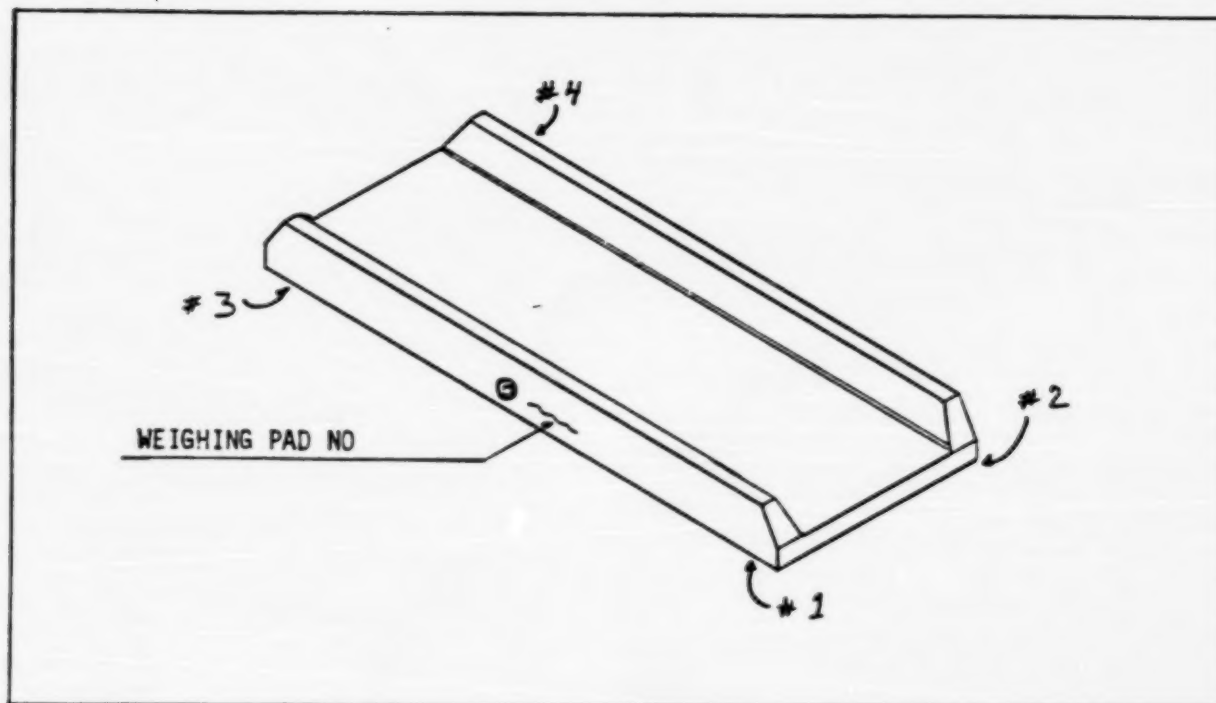
2.14 Thermal Sensitivity Shift .0008 %/F

2.15 Identification Standard

CERTIFIED
 FEB 22 1985

TABLE C-1

Localization of each load cell



<u>Weighing pad no</u>	<u>Cell no 1</u>	<u>Cell no 2</u>	<u>Cell no 3</u>	<u>Cell no 4</u>
1	100 410	100 412	100 418	100 415
2	100 402	100 408	100 407	100 406
3	100 404	100 417	100 405	100 409
4	100 413	100 414	100 416	100 411
5	100 400	100 403	100 401	100 399

TABLE C-2

Load cells calibration factors

<u>Cell no</u>	<u>Full scale output (mV/V)</u>
100 399	3,002
100 400	2,997
100 401	3,001
100 402	3,001
100 403	2,999
100 404	3,003
100 405	3,007
100 406	3,006
100 407	3,005
100 408	2,998
100 409	3,004
100 410	2,999
100 411	2,999
100 412	3,000
100 413	2,994
100 414	3,002
100 415	3,001
100 416	2,998
100 417	3,000
100 418	3,001

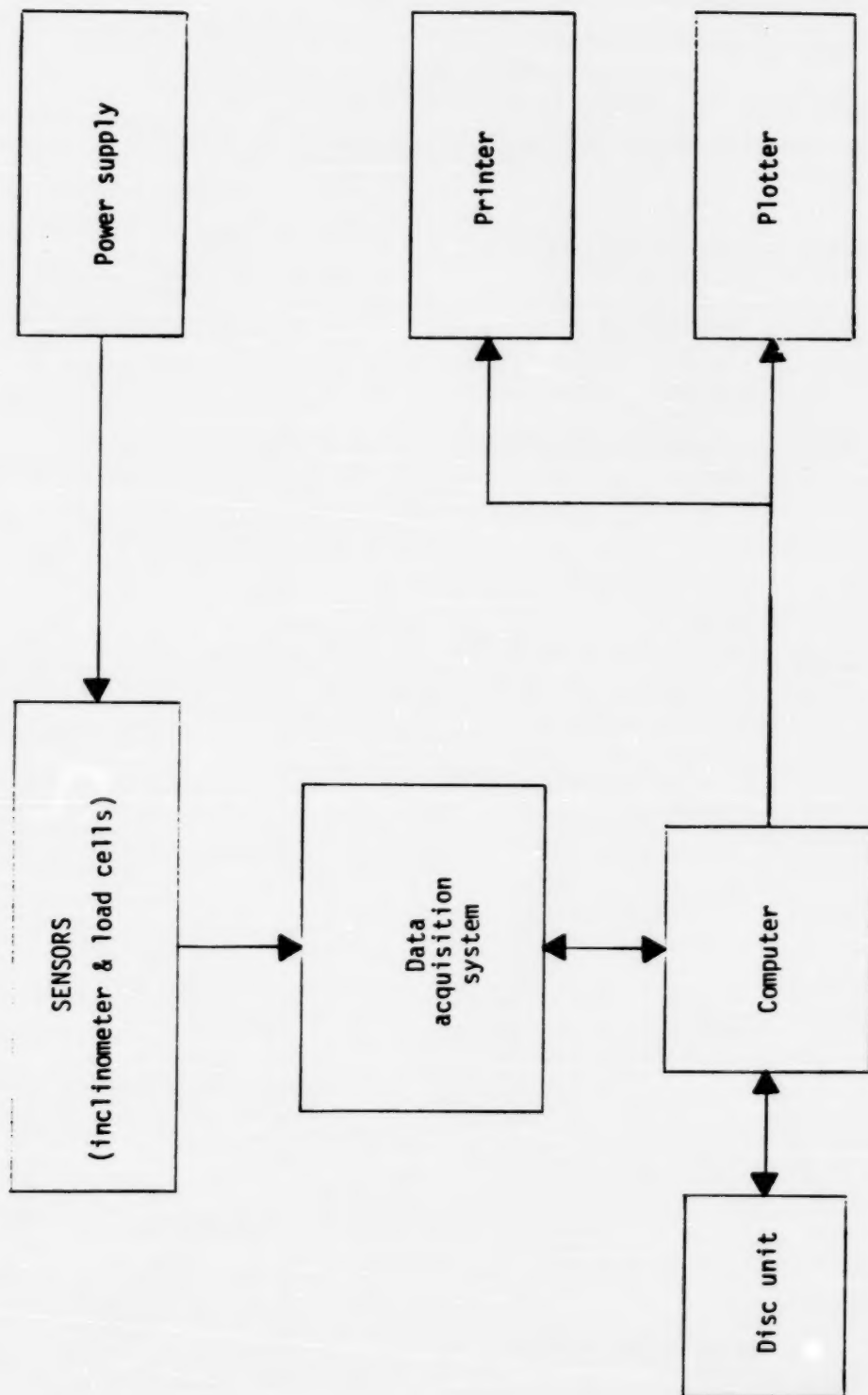
TABLE C-3

Electrical connexions of the load cells
(for each weighing pad)

Localisa- tion of the cell	Pair number	Load cell wire	Position on the connectors	
			24 pins	26 pins
no 2	1 - white	EX + red	A	A
	1 - black	EX - black	B	B
	2 - white	S + green	C	C
	2 - black	S - white	D	D
	3 - white		E	E
	3 - black		F	F
no 1	4 - white	EX + red	G	G
	4 - black	EX - black	H	H
	5 - white	S + green	J	J
	5 - black	S - white	K	K
	6 - white		L	L
	6 - black		M	M
no 4	7 - white	EX + red	N	N
	7 - black	EX - black	P	P
	8 - white	S + green	Q	R
	8 - black	S - white	R	S
	9 - white		S	T
	9 - black		T	U
no 3	10 - white	EX + red	U	V
	10 - black	EX - black	V	W
	11 - white	X + green	W	X
	11 - black	S - white	X	Y
	12 - white		Y	Z
	12 - black		Z	a b d

Note: - The 24 pin connectors are on the weighing pads and the 26 pins are at the other end of the cables.

- The 24 wire cable has 12 pairs, one marked white wire attached with a non identified black one.



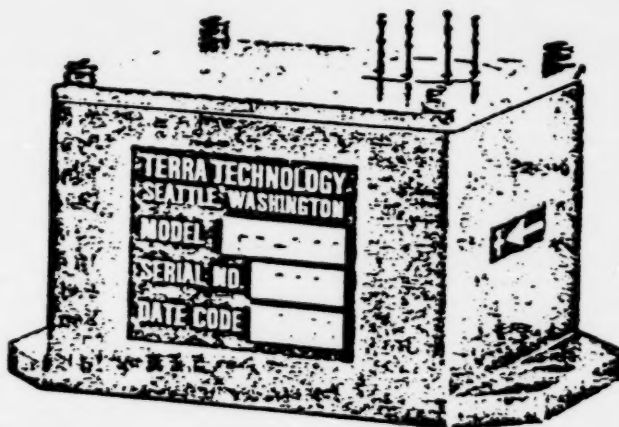
TYPICAL DATA ACQUISITION SYSTEM



SERVO ACCELEROMETER

TERRA — FLEX® MODELS SA-102 & SA-111

INTERTECHNOLOGY
1 SCARSDALE ROAD, DON MILLS, ONTARIO M3B 2Y2 - (416) 443-5500
MONTREAL OTTAWA WINNIPEG CALGARY VANCOUVER
(514) 883-0930 (613) 883-0522 (204) 895-3037 (403) 256-3088 (604) 271-9538



U.S. Patent No. 4,088,027

- RUGGED, FLUID DAMPED FLEXURE SUSPENSION
- LOW THERMAL COEFFICIENT
- FIELD RANGEABLE
- USER CONNECTABLE 1g BIAS
- EXCELLENT BIAS STABILITY
- TELEMETRY MODELS AVAILABLE
- CHOICE OF SENSITIVE AXIS
- BROAD DYNAMIC RANGE
- LOW OUTPUT IMPEDANCE
- WIDE FREQUENCY RESPONSE

The Terra — Flex® SA Series Servo Accelerometers offer the unparalleled combination of excellent stability and ruggedness. Designed for maximum user flexibility, standard features include field rangeability, choice of sensitive axis direction, and a 1g bias network which can be user connected.

A special alloy flexure system and stable differential electronic detector/amplifier are combined to provide high sensitivity, broad dynamic range, ruggedness, long term stability and extremely low thermal drift. Hysteresis is insignificant and resolution is effectively infinite. The flexure suspension, unlike pivot and jewel suspensions, is not subject to progressive deterioration in the presence of vibration and shock. Handling (peak) shock breakage, common with quartz suspensions, is also virtually eliminated.

The SA Series accelerometers operate from a wide range of input voltages and can be used for a variety of acceleration measurement applications including seismic monitoring, control systems, vibration monitoring, structural response, vehicle testing, stable platforms and tilt sensing.

SPECIFICATIONS FOR SA-102, SA-111

RANGE: ⁽¹⁾	±0.1 to 10g
FULL SCALE OUTPUT: ⁽²⁾	±5 VDC (std) to ±10 VDC (max), ±0.5%
INPUT VOLTAGE:	±9 to 18 VDC; + 18 to 30 VDC (Telemetry version only)
INPUT CURRENT:	±8 ma dual supply; 20 ma single supply (Telemetry version only)
OUTPUT IMPEDANCE:	< 10 ohm
LINEARITY ERROR:	< 0.05% full scale
HYSTERESIS:	< 0.01% full scale
RESOLUTION:	< 0.0005% full scale
TURN-ON REPEATABILITY:	Better than 50 µg
CROSS AXIS SENSITIVITY:	< 0.0005 g/g
FREQUENCY RESPONSE:	0 to 50 Hz, ±2 dB (std.), other frequency responses from 10 to 150 Hz available
NOISE: 0-50 Hz	< 5µg (peak-to-peak)
0-1000 Hz	< 10µg (peak-to-peak)
0-1 MHz	< 20µg (peak-to-peak)
CASE ALIGNMENT:	< 0.5°
OPERATING TEMP. RANGE:	-40°F to 180°F (std); -65°F to 300°F (special order)
SHOCK:	500g, 5 ms; 3000 g, 0.1 ms
VIBRATION (SINE, PEAK):	15g, 20-100 Hz; 20g, 100-2000 Hz
WEIGHT:	7 oz (0.2 kg)
	SA-102 SA-111
BIAS, HORIZONTAL:	0.010g 0.005g
BIAS, VERTICAL:	0.020g 0.010g
HORIZ. BIAS TEMP. COEF:	50µg/°F max. 20µg/°F max.
SCALE FACTOR TEMP. COEF:	100 ppm/°F max. 50 ppm/°F max.

NOTES

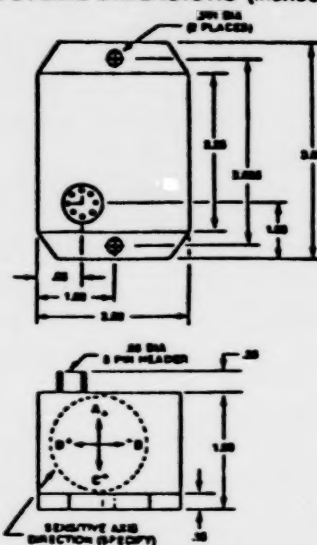
(1) UNITS ARE SUPPLIED WITH 0.1g INTERNAL RESISTOR. EXTERNAL RESISTORS ADDED TO INCREASE RANGE. STANDARD RANGES ARE: ±0.1, 0.25, 0.5, 1.0, 2.0, 5.0 AND 10.0g. ASYMMETRICAL RANGES AVAILABLE.

(2) FULL SCALE OUTPUT SHOULD NOT EXCEED 10 VDC OR 75% OF INPUT VOLTAGE, WHICHEVER IS SMALLER. TELEMETRY VERSIONS SUPPLIED WITH 0-5 VDC OUTPUT.

ORDERING INFORMATION: Specify model number, range, sensitive direction, and performance options desired. For example, SA-102-1-B-F is a Model SA-102, ±1g, with case alignment of 1/4° and telemetry output. Full scale output is ±5 VDC unless otherwise specified on the order (except for telemetry versions which are 0-5 VDC).

WANT MORE INFORMATION? CONTACT TERRA TECHNOLOGY CORP. OUR FACTORY PERSONNEL CAN PROVIDE YOU WITH ADDITIONAL INFORMATION, WHETHER IT'S FOR A SINGLE INSTRUMENT OR A COMPLETE SYSTEM PROPOSAL.

OUTLINE DIMENSIONS (inches)



PIN	CONNECTIONS	
	DUAL SUPPLY	SINGLE SUPPLY
1	+ Power	+ Power
2	- Power	Power Grd.
3	Pwr. & Sig. Grd.	Signal Grd.
4†	Output	Output
5†	1g Bias	1g Bias
6*	1g Bias	1g Bias
7	Self Test	Self Test
8	Self Test	Self Test

*Jumper pins 5 & 6 for 1g bias, no connection for horizontal operation

†Range resistor connected between pins 4 & 5.

PERFORMANCE OPTIONS

- A. NON-STANDARD RANGE (Specify)
- B. CASE ALIGNMENT: 1/4°
- C. INITIAL BIAS: 0.002g (horizontal)
0.005g (vertical)
- D. BIAS T.C. 10 µg/°F (SA-111 only, not applicable to vertical bias)
- E. SCALE FACTOR TOLERANCE: ±0.1%
- F. TELEMETRY OUTPUT: 0-5 VDC

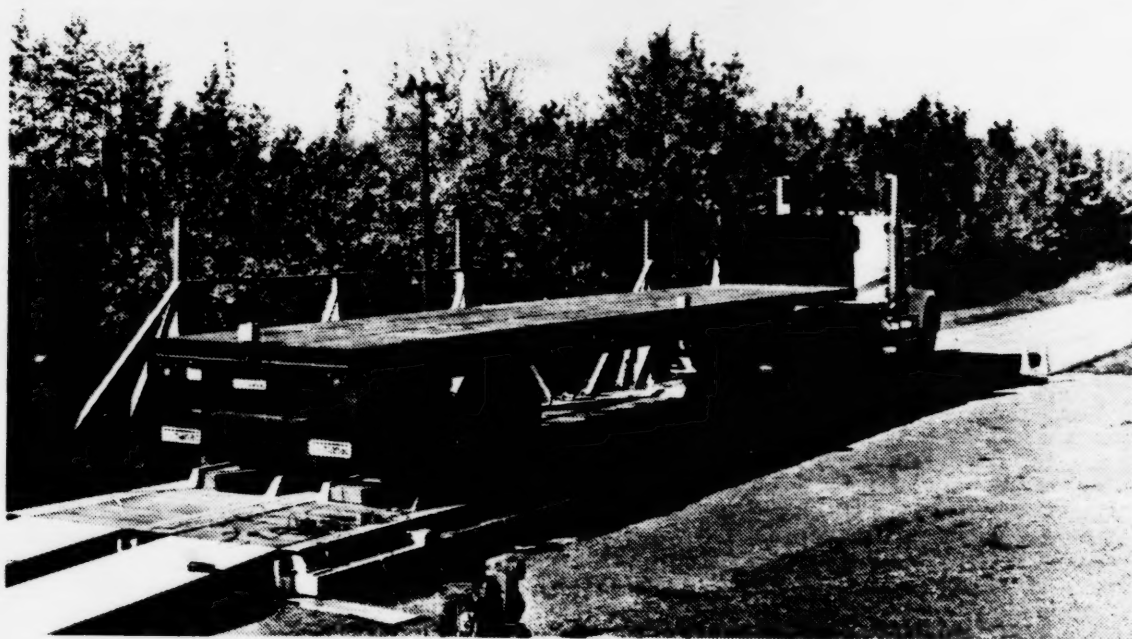
TERRA TECHNOLOGY CORP.

3880 148TH AVENUE N.E., REDMOND, WASHINGTON 98052 • Phone (206) 883-7300 • Cable TERRATECH • Telex 32-0357

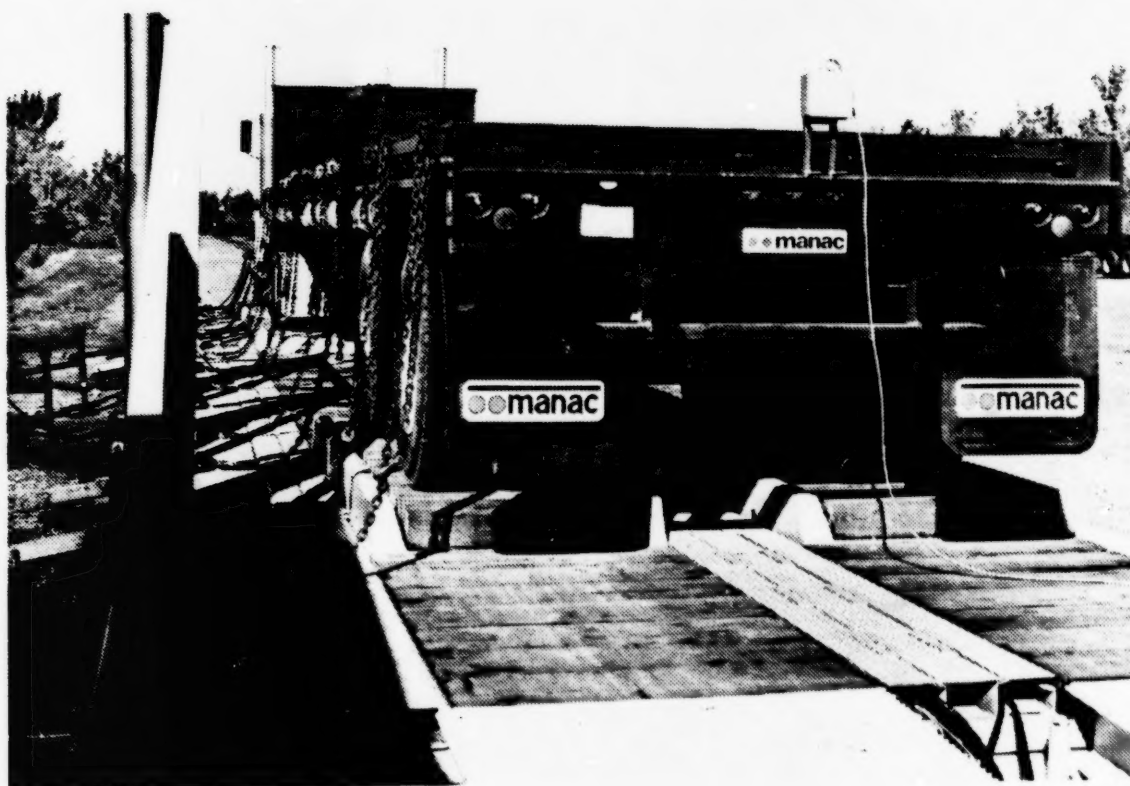
APPENDIX D

Pictures of the tilt table in use





Unloaded vehicle ready for tilt test



Unloaded vehicle ready for tilt test



Unloaded vehicle tilted at 35°



Unloaded vehicle tilted at 35°



Unloaded vehicle tilted at 35°



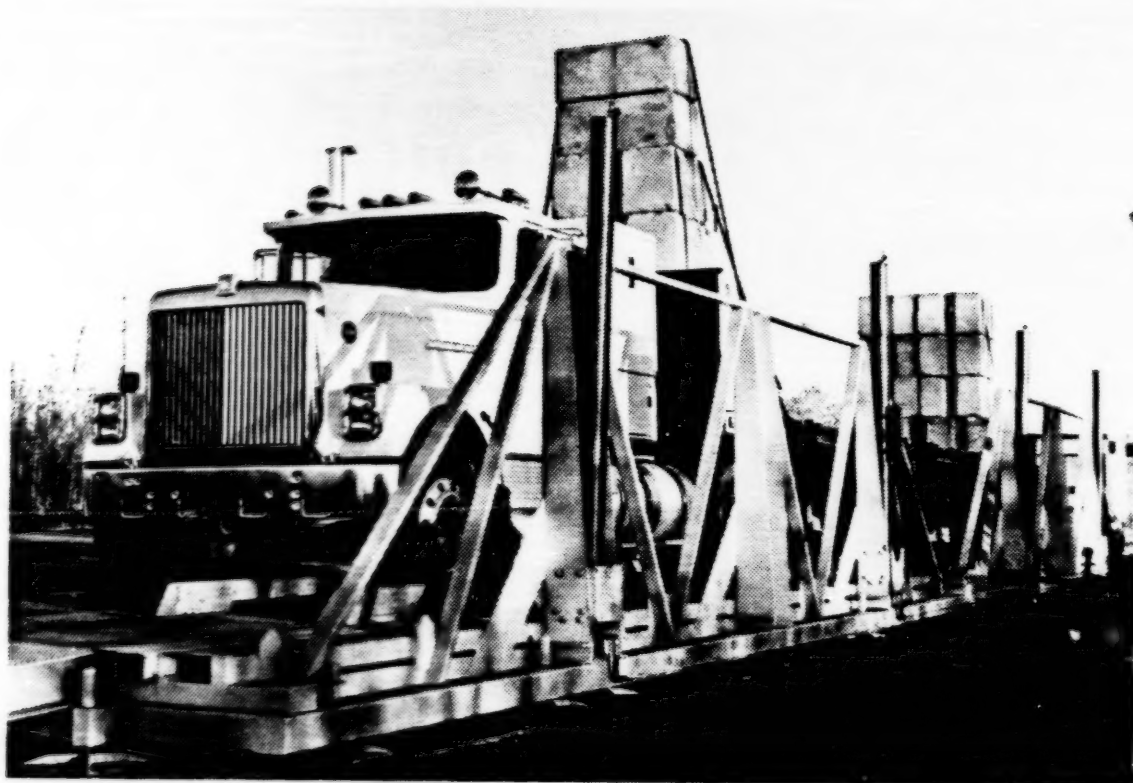
Unloaded vehicle tilted at 35°



Trailer wheels on a weighing pads



Loaded vehicle ready for tilt test



Loaded vehicle ready for tilt test



Loaded vehicle ready for tilt test



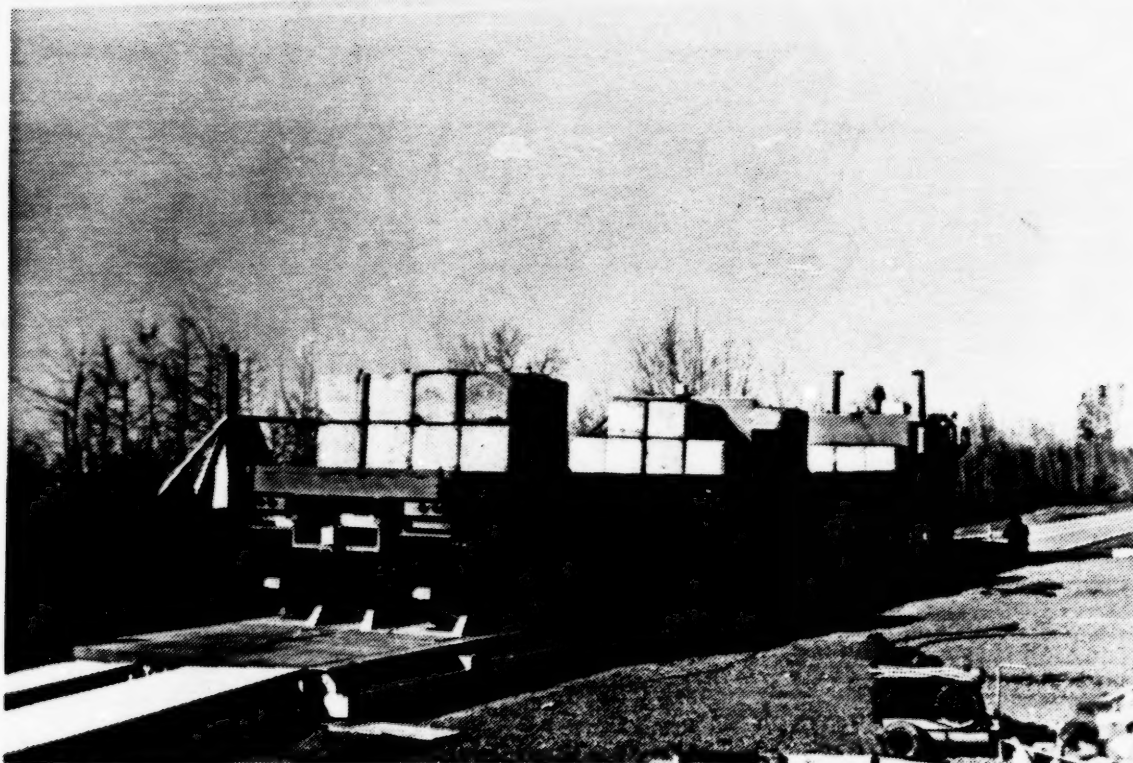
Loaded vehicle at rollover



Loaded vehicle at rollover



Loaded vehicle at rollover



Road train installed on the tilt table